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Purpose The *Air Force Journal of Logistics* provides an open forum for the presentation of issues, ideas, research, and information of concern to logisticians who plan, acquire, maintain, supply, transport, and provide supporting engineering and services for military aerospace forces. It is a non-directive, quarterly periodical published under AFR 5-1. Views expressed in the articles are those of the author and do not necessarily represent the established policy of the Department of Defense, the Department of the Air Force, the Air Force Logistics Management Center, or the organization where the author works.

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Manuscripts Manuscripts are welcome from any source desiring to deepen or broaden the knowledge and understanding of Air Force logistics professionals. They should be typed (double-spaced) and be between 1500-3500 words. Figures, graphics, and tables (separate pages) should be numbered consecutively within text (AUTOVON 446-4087; Commercial (205) 279-4087).

Taking Microcomputers to War: What Transporters Have Learned

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Each year, in deployment exercises such as Team Spirit in Korea and Bright Star in Egypt, critical pieces of equipment cannot be located when needed, even though vast quantities of supplies flood the exercise area. Whether stored in huge Harvest Eagle warehouses or flown directly to a bare base location and piled on the ramp or stacked in temporary storage areas, a particular piece of "lost" equipment most often cannot be quickly located due simply to *lack of information* on exactly where it is stored or whether or not it is even available. This is unacceptable performance, given the short-notice, fast-paced brand of war that threatens the US in today's world. Logisticians need to gather, store, and use huge amounts of information in order to respond quickly to changing situations.

In peace we cope with the information overload problem by putting powerful mainframes and microcomputers to work. But in war, we may find a totally different situation. If we deploy to a bare base or austere forward operating location and operate at surge levels with minimum manning, the environment may prohibit or restrict the use of the very tools we depend on to bring wartime information requirements under control and contend with the rapid and tailored response necessary to stall an enemy offensive. We may be further hampered by not even knowing what *type* information is actually needed. During the annual Team Spirit exercise held in Korea, Air Force Logistics Management Center (AFLMC) transportation analysts observed simulated wartime logistics operations at a half dozen logistics support bases and discussed wartime information needs, problems, and solutions with over 30 senior and middle transportation managers participating in the exercise. Although this effort focused on the transportation function, the analysts found many transportation problems were clearly applicable across the entire logistics spectrum.

Observations fell into two basic areas:

(1) How can we ensure the wartime environment is sufficiently hospitable to the microcomputers we will be depending on for information processing?

(2) What information is actually necessary for successfully prosecuting the war?

Micros and the Environment

The first task is to determine the working environment, particularly with regard to the automated data processing (ADP) equipment which would be used at a bare base. This information is important because we should practice in peace the way we expect to operate in war; therefore, we should buy hardware and design software capable of operating efficiently and reliably under wartime conditions.

Several basic elements need to be present for a computer of any kind to operate effectively. First is a source of power. Second is a dry, relatively clean work area. And third, although not a physical operating requirement, is some method of exchanging processed data with the user.

Power Source

Microcomputers are surprisingly rugged and generally tolerant of power fluctuations when compared to other computers. Additionally, micros require very little power and can often operate on batteries for short periods of time. Nevertheless, for extended use, microcomputers require some consistent source of external power. If power is not available directly from the host nation, it will probably be available from generators. Therefore, the power problem is not one of availability, but rather one of reliability and quality (consistent in terms of voltage and cycles). Even in the best of times, reliability and quality of electrical power in foreign countries do not match what US users are accustomed to; during war they are likely to be even worse.

Observations of the power source at Kimhae AB, Korea, during Team Spirit clearly demonstrated the impact of unreliable power supplies. One captain, who had been at several Team Spirit exercises, observed that his unit's minicomputer, housed in a permanent facility, often required "rebooting" due to power fluctuations—even though a line filter was attached to the power source. Similar conditions were reported by participants of Bright Star, the annual Joint Chiefs of Staff (JCS) exercise in Egypt. Likewise, locally generated power, such as that from diesel powered generators, falls short of the high quality power available in the US. Additionally, either power source—local or generated—is susceptible to failure because of lack of fuel, sabotage, enemy actions, etc. It is not hard to see the logistical implications of the simple task of keeping a base-wide inventory of generators in constant use, fueled and maintained. Will the jerry can again become a backbone of military capability? (Unexpected problems can arise even with the ordinary jerry can—during one exercise, refueling personnel were unable to reach the fill spouts of platform-mounted gravity feed fuel tanks.)

The unavailability of high quality, reliable power affects all logistics activities using ADP. This area is of particular concern since the answer to many information shortfalls entails additional dependence on ADP equipment. (See, for example, the transportation computer applications accompanying this article.) If we intend to go to war with microcomputers and depend on them to increase mission capability, then we must procure and stock standby, uninterruptible power supplies (UPS) to ensure we have continuous, reliable electrical power. Provisions to purchase this type of equipment should be made available to users.

Location

The second requirement for a computer system is the need to have a somewhat clean operating environment. This does not

appear to be a serious problem since, as a minimum, operators will be housed in tents and, if conditions warrant, the tents will be heated. Even if a tent has a dirt floor, it should be a satisfactory operating location for a microcomputer if only minimal care is taken to keep the system clean.

Micros have proven themselves to be extremely rugged and capable of operating reliably under a variety of conditions. Microcomputers were successfully used on Grenada and Barbados during Urgent Fury to run the Deployable Mobility Execution System (DMES). Further, the Data Systems Design Office (DSDO) has used micros in the cold of Alaska and the heat of Honduras to run the Computer Aided Load Manifesting (CALM) System. Under each of these situations, the micros performed satisfactorily.

Information Exchange

A third area of interest for an effective computer system is some method of exchanging data between computers and moving information (processed data) to the ultimate user. Effective war fighting could be severely limited by an ADP system if it is not possible to exchange the information with others requiring the information for decision making.

If users are in close proximity to each other, sharing information is generally not a problem since, as a minimum, floppy disks or hard copy printouts can be physically exchanged. "Close proximity" would be defined as on the same base or within a few miles. If users are separated by more than a few miles, the exchange of data is more easily handled by other means. The primary method is electrical transmission of digitized information over phone lines using a modem. Unfortunately, this method has unique problems of its own.

Typically, long distance information exchanges take place over normal telephone lines and the data is electronically transmitted to the user. To complete the transmission, it is necessary to have a reliable phone network. Unfortunately, reliable, high quality telephone service such as we enjoy in the US simply does not exist throughout most of the world. Telephone service in other countries during peacetime often falls short of the quality needed for data transmission, and we can expect the wartime system to be almost totally unreliable. Additionally, some telephone systems (particularly in Europe) are electrically different from those in the US and require special equipment for data transmission. Therefore, any upward reporting of information, normally accomplished electronically over peacetime telephone lines, will need an alternate method as a backup during war.

"Logisticians need to be aware of the limitations of ADP in a wartime environment."

The environmental barriers mentioned do not necessarily exclude ADP (micros) from effective wartime duty. However, logisticians need to be aware of the limitations of ADP in a wartime environment. As long as we plan to deal with these limitations, microcomputers can help solve problems associated with informational shortfalls and assist in increasing the capacity for rapid flexible response.

Information Requirements

Given the capability of using microcomputers (with the aforementioned limitations recognized), it is worthwhile to look specifically at what kinds of information deploying transporters need. Two general areas of information, or lack of information, could affect mission accomplishment. *External* (that is, external to the base environment) considerations include the basic condition of the host or occupied country's transportation infrastructure and available in-country resources. *Inventory control,* within the transportation unit, ensures adequate information concerning unit resources to allow accurate estimates of mission capability.

Theater Resources

Although most transportation units (particularly overseas) have some method of tracking transportation infrastructure information, no formal or standard means is currently used to actively seek out, record, and update the information. Transportation units operating during peacetime do not have a means to actively collect and maintain infrastructure intelligence on in-country road systems, rail systems, inland waterways, seaports, and airfields. A method of gathering details on items such as the general conditions of roads, height or weight limits of bridges or tunnels, traveling times, service facilities, general conditions of docks, unloading capabilities at docks, and harbor draft limits does not currently exist.

Another external information requirement is some knowledge pertaining to the availability of local supplies which could be used during a surge situation. A primary concern for transportation is the availability of petroleum products, particularly fuel. A secondary consideration is the availability of spare parts for vehicles. If we continue to buy more foreign vehicles in direct support of our mission, knowledge of locally available spares to repair these vehicles will become increasingly important.

Similar to vehicle operations and vehicle maintenance, traffic management is also concerned with expendables available in the local area such as lumber, plywood, nails, and small hand tools. In the traffic management area it would be of even greater importance to know about the availability of indigenous manpower, particularly stevedores. Generally, external information requirements for resources are similar enough across all branches of transportation such that one system could adequately handle the needs of each. A system to gather and store information concerning locally available resources would add to the ability of commanders to complete their wartime missions.

Unit Information

Commanders need inventory control information since severe shortages could impact mission accomplishment. Although this information closely resembles capability assessment, we treat this area separately because inventory control deals only with equipment, whereas capability assessment considers manpower as well. Inventory control, of course, is a requirement in both peacetime and during war. The issue, however, becomes more critical during war since lack of even the simplest items could hinder or prevent critical mission accomplishment.

A primary concern of transportation squadron commanders is knowledge of their vehicle inventory. Information concerning the alignment of vehicles and the overage or shortage of particular vehicle types is extremely valuable when making mission capability decisions. Currently, this information is maintained in a journal or ledger, or on a status board with a grease pencil. However, an AFLMC project, *Computer Assisted Transportation System (CATS),* will extend

the squadron commanders' decision capabilities by putting the necessary information in a microcomputer where it can be analyzed and accessed easily and quickly, thus giving commanders the needed edge for rapid, flexible response.

A second wartime information need is the ability of commanders to assess their capability to repair and field vehicle assets. During peace we use base-level computers to manage vehicle maintenance activities. However, at a deployed site during war, where we may operate from a mobile maintenance facility, we will not have the luxury of large mainframe computers to help manage the maintenance effort even though the workload and number of vehicles could be even greater. This dictates the need for a deployable, automated vehicle maintenance system to help improve mission sustainability.

Currently, transportation capability assessment seems to be based on the "gut feeling" of commanders or branch chiefs as to what they can accomplish. Unfortunately, this reaction may be based on incomplete information since commanders at deployed locations do not always have knowledge of the inventory and are likely to be unfamiliar with the skills, capabilities, and experience of their people. In order for commanders to make accurate capability assessments, they need information from an inventory system and a personnel system, and knowledge of available external resources. These pieces of information can allow decisions based on available manpower, vehicle assets, and supplies. Concise, real time reporting gives commanders the ability to make accurate capability assessment judgments.

Summary

Current transportation information sources and techniques basically support the wartime mission; however, improvements can be realized by introducing some new sources and more fully capitalizing on microcomputer capabilities:

- Battery backup and electrical power filtering devices should be procured and stocked with forward based supplies (Harvest Eagle, etc.) or identified to deploy with mobility units.
- Automation efforts requiring upward reporting or the exchange of information should not depend solely on electronic means. The physical exchange of hard-copy printouts or mass storage media should always be available as an alternate means of exchanging information.
- Transportation policy should require a standard method to collect critical information concerning a potential deployment location's transportation infrastructure.
- A standard method or procedure to gather information on critical locally available resources is needed.
- A flexible inventory system for maintaining squadron resources would allow better tracking of resources and improved employment decision-making.
- Transportation needs a deployable microcomputer vehicle maintenance management system.

References

1. Blair, Major Robert L. *ADP Backup — An Evaluation*. Student Paper #LD49015A. Leadership and Management Development Center, Air University, Maxwell AFB AL, 1981.
2. Byers, Richard. *Transportation Operational Personal Property Standard System*. AFTPC/DSDO/LGTT, 1985.

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Current Microcomputer Applications for Transportation

- *Transportation Mini Information Library (T-MIL):* This program is for transportation workload and productivity analysis at the MAJCOM level. The program allows MAJCOM transportation functions to access data bases at the Data Systems Design Office and analyze information for any transportation workcenter for each base in their command. The program runs on the Z-100 or Z-248. Status: Operational.
- *Deployable Mobility Execution System (DMES):* Provides a computer assisted aircraft load manifesting capability. It eliminates manual computation for aircraft load distribution and allows on-the-spot ability to react to last minute changes in cargo weights, types of aircraft, allowable cabin load (ACL), frustrated cargo, number of passengers, etc. Status: Complete for Hewlett-Packard computer. Has been rewritten for the Zenith Z-100 computer and renamed *Computer Aided Load Manifesting (CALM)*. Status: Both programs are in worldwide use.
- *On-Line Vehicle Integrated Management System (OLVIMS):* Replaces the current, batch oriented Vehicle Integrated Management System (VIMS) with real time state-of-the-art software. Increment 1 was available in July 1986 and allows Z-100 or Z-248 microcomputers to access and edit maintenance data stored on a mainframe computer. Increment 2, scheduled to be released in July 1987, will move the mainframe data base to the microcomputer giving an independent system. Increment 3 will add enhanced capabilities, such as work order preparation.
- *Computer Assisted Transportation System (CATS):* Designed to improve the capabilities of base-level vehicle operations units to provide mission support. The project consists of two modules: Driver Evaluation and Fleet Analysis. The CATS program runs on a Z-100 computer. Status: The Driver Evaluation portion is complete and has been distributed. Fleet Analysis is scheduled for prototyping in the Fall of 1986.
- *Freight Documentation Automation (FDA):* Automates the preparation of Surface Freight and Packing and Crating documentation to include Government Bills of Lading (GBLs), shipping labels, and Special Handling Data/Certification. The system is being developed for the Z-100 and Z-248. Status: The Packing and Crating module is complete, but waiting for availability of forms used in the program. Anticipate completion of the Surface Freight module (FDASF) for prototyping by December 1986.
- *Transportation Operational Personal Property Standard System (TOPS):* A DOD project headed by HQ Military Traffic Management Command to standardize operating procedures throughout DOD and to use automation to reduce the manual administrative workload associated with the preparation, control, and distribution of documents and the maintenance of registers, rosters, and files related to personal property actions. Status: Prototype testing at four selected locations during July - December 1987. CONUS implementation will begin January 1988.
- *Cargo Movement Operation System (CMOS):* This project is designed to bring total automation to the freight portions of the Traffic Management Office. Overall development of the project is being done by the Data Systems Design Office. As a result of advance testing of software applications, an Air Freight module (AIRMOD) was developed and is currently operational. A follow-on increment will apply data automation at working (base/unit) levels to improve in-place planning and execution during crisis situations. The prototype system is based on state-of-the-art mini- and microcomputer technology, with on-line terminals at selected work stations.

Logistics for the Fighter Wing of the Future

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Colonel Robert A. Wiswell, in the Summer 1986 issue of AFJL, asked readers to propose logistical concepts to support a new fighter wing structure better suited to modern air warfare ("The Composite Fighter Wing: A New Force Structure and Employment Concept Needing Logistical Attention"). This article responds to that challenge.

A new fighter wing of the future has been proposed. This concept envisions wings comprised of A-10s, F-16s, and F-15s (plus the advanced tactical fighter, when operational) with a blend of each according to their mission. For example, a composite close air support wing would have two A-10 squadrons and one F-16 squadron, and a counterair wing would have a mix of F-15 and F-16 units. (4:12)

While possibly offering a better method of engaging and defeating the enemy, potential problem areas associated with this concept (which basically changes the structure of our tactical air forces) loom on the horizon and must be overcome. A prime stumbling block is logistics—the ability to maintain and support the multiple aircraft types of this new wing structure. Three major areas of concern are facilities, spares, and manpower. An analysis of each, vis-a-vis adoption of the composite wing concept, will be presented. Following that, recommendations for improving overall weapon system reliability and maintainability to further enhance this concept—while simultaneously relieving the overall logistics burden of airpower—will be offered. But first, we need to review the composite wing concept.

Composite Fighter Wing

> As now structured and configured, Air Force tactical fighter forces cannot respond with a tailored, appropriately sized, combat effective force that in and of itself contains all required capabilities.(4:11)

Under the composite concept, the current inventory of fighter aircraft would be blended and tailored to better meet the demands of a wing's prime mission. Furthermore, the composite wing structure offers the opportunity to daily train like the war-planners envision we will ultimately fight the air war; namely, as composite force packages. Having the ability to launch the composite strike force from one base, in lieu of the planned and currently practiced midair join-up, offers the capability for more highly coordinated and effective employment of airpower, as well as the ability to independently construct strike packages in the event of disrupted command and control.

This is a new and somewhat bold approach to how to best employ our current and future fighter forces. Likewise, the logistics to support this concept will require new, perhaps bold, and innovative approaches. Above all, previous logistics "sacred cows" may become prime targets. Facilities are somewhat of a sacred cow—new aircraft or new organizations generally require new facilities. This may not always be the case.

Facilities

Consider a typical stateside Tactical Air Command (TAC) fighter wing, the 354th TFW, an A-10 wing based at Myrtle Beach AFB, South Carolina. Postulate moving in a squadron of F-16s from the 363rd TFW now based at Shaw AFB, South Carolina, and deleting a squadron of A-10s. Facilities requirements would not be so different that daily flying could not go as programmed before the conversion. An F-16 squadron needs little that an A-10 squadron suite of facilities cannot provide. Flight-line maintainers could move right into the recently vacated space. This is, in fact, how Red Flag exercises are run, and run very successfully. Additionally, recent aircraft conversions of most TAC wings have produced better and more abundant facilities. Launching, recovering, and servicing F-16s should present no major facility problems, since these on-equipment actions are largely independent of facilities.

Facility-dependent maintenance is off-equipment or off-flight-line maintenance, such as repairing line replaceable units (LRUs) or "black boxes," overhauling engines, and conducting phase inspections. In our test case, there are no major constraints to accomplishing each of these maintenance actions. For repairing LRUs, relocation of an avionics intermediate station (AIS) to the gaining organization should not be difficult. In the 354th case, their A-10s were preceded by A-7s, a much more avionics-intensive aircraft. This resulted in some excess space to the A-10's avionics requirements. If problems did present an immediate AIS transfer, a daily shuttle running between the 354th and 363rd for LOGAIR shipments could be used to transport repairable/repaired LRUs. War readiness spares kit (WRSK) assets and cannibalized LRUs from scheduled non-flyers could provide needed LRUs for scheduled flyers, if the repair pipeline was not responsive enough for daily flying requirements.

This is a very basic system, but it would work. In fact, a more sophisticated version, the centralized intermediate logistics concept (CILC), is in use in PACAF with black boxes being shipped in from all over the theater to the centralized intermediate repair facility (CIRF) for repair and redistribution. This system could also be adopted in USAFE by moving and consolidating the intermediate repair facilities to England, Spain, or even Sardinia. The intratheater distribution system for spares—the European Distribution System (EDS)—already exists. Adopting such an approach would not only provide the intermediate-level support for composite wings, but would also enhance survivability by moving the vulnerable pieces of support equipment to the more protected rear areas of the theater.

Turning to engine repair, the A-10 and F-16 each have different engine repair concepts. Simply put, A-10 engines are torn down to their smallest component for repair, while F-16

engines are repaired by replacing entire modules with those repaired by the depot. Deleting an A-10 squadron's complement of engines and replacing them with F-16 engines would present few, if any, problems for the 354th engine shop. Work could begin immediately. This, of course, presumes the transfer of F-16 engine peculiar tools and equipment. What would be required is an engine hush-house for F-16 engine runs. This facility could be constructed after F-16 beddown. Likewise, additional engine module storage space would probably be required at the 354th. A commercially available prefabricated metal building set on a concrete slab could provide the additional engine module storage space.

Conducting F-16 phase inspections in lieu of A-10s would require very little. Basically, all that would be required is to empty one A-10 phase dock, replace it with F-16 tools, equipment, and technical data, and begin work. Admittedly, this is a very broad brush treatment, and some snags would undoubtedly arise. The point to be made, however, is that, from the facilities standpoint, there are no "showstoppers." (For F-16 purists, there is no present workaround to the hydrazine servicing facility; one would have to be built.)

Spares

As part of the transfer of the F-16s, a squadron's complement of spares would accompany the aircraft. Additionally, an entire WRSK for the squadron would also be included. Designed and filled to support a squadron for 30 days, these assets would be available (in TAC under the combat oriented supply organization (COSO) concept the WRSK is "open" and readily available) to support daily flying. Likewise, TAC's combat oriented repair evaluation (CORE) program, designed to monitor the base level asset repairable cycle, ensures that parts are repaired quickly and the shelves in base supply stay full. Lateral supply support from like aircraft units will still be available and, depending upon need, launching an aircraft to pick up a needed spare(s) is still an option. Rounding out spares support are the depot inventories and controlled items as well as the parts available from the manufacturers themselves. Finally, cannibalization is always available and through judicious usage can certainly mitigate a spares shortfall.

Some adjustments in spares/WRSK stockage levels should be made to counter the loss of the larger parts supply pools available in a three squadron wing versus the composite wing. For example, there will be two-thirds less broken aircraft (only one squadron's assets vice three) available for possible cannibalization of a needed part to fix a scheduled flyer. Likewise, the WRSK will also have two-thirds less assets available upon which to draw. These adjustments would be subject to a period of refinements. Initially, calculated best-guess based upon off-station deployments would provide a new baseline from which to operate. Flight operations, over time, would then validate any further adjustments required to the WRSK levels. Finally, as mentioned, if adoption of the central repair facility concept was implemented, judicious distribution of serviceable assets to squadron(s) with grounded aircraft could provide a partial solution to spares shortages.

Manpower

This is the long pole in the composite wing tent. Under current AF manpower directives, more people would probably be required to maintain an F-16 squadron in the composite wing than a squadron of F-16s at an F-16 homogeneous wing. One possible approach to solving this problem would be to allow motivated individuals within the shortage Air Force specialty codes (AFSCs) to expand their capabilities to enable them to work on both types of aircraft in a composite wing. This AFSC enhancement/enrichment program could be implemented, for example, with the avionics, hydraulics, egress, fuel system, and armament system AFSCs. Besides offering a challenge to motivated individuals, the impact of shortages in particular AFSCs could be lessened. The precedent is already set.

In TAC's cross utilization training (CUT) program, individuals from one AFSC are trained on certain predetermined tasks in another AFSC. For example, aircraft crew chiefs are taught how to remove and replace certain LRUs or assist in ejection seat installation/removal. With the CUT program, individuals are CUT on only one type of aircraft; however, under this new program, individuals would be CUT on different types of aircraft, in this case A-10s and F-16s.

Another possible approach could come from the adoption of the CILC. By having a main centralized repair facility, in lieu of AISs spread out among the various composite wings, less people would be required, overall, to operate the CIRF.

Through consolidation and centralization, less avionics personnel would be required to operate the facility. The manpower savings realized through the consolidation could then be applied to fill the manpower shortages created by the removal of the F-16 squadron from its F-16 wing. In essence, a zero balancing of manpower overages and shortages would take place. This is not to say that every hole would be filled, but rather the number of holes could probably be reduced to a manageable level and ultimately not adversely affect mission accomplishment.

Finally, there is the third option of using a combination of both of these methods to overcome manpower shortages created by the composite wing concept. Implementing this approach, conversion of AFSCs from, for example, avionics to hydraulics might be smarter than the straight conversion of an off-equipment avionics AFSC to an on-equipment avionics AFSC. These decisions could be made as the concept matures and the wings gain experience with the support needs of composite units.

As presented, the logistical impediments to the composite wing, while formidable, could be managed and viable workarounds developed to make the concept a reality. Admittedly, initial operations might be rough, but a normal daily flying schedule could probably be realized with surprisingly little difficulty. As the experience base grows, we might find that the actual new facilities required, spares stockage adjustments needed, and manpower shortages expected may be far less than envisioned.

The Real Showstopper

All these factors boil down to this: the using command logistics infrastructure could make the composite wing work *right now* if told to do so. This has been the case in the past; i.e., virtually every new tactical weapon system has had to overcome numerous iterations of logistics impediments that threatened to seriously hamper projected operations. This will continue to happen because, with the exception of some token

government-furnished equipment (GFE), each new tactical weapon system is defined with a new logistics support system all its own. Furthermore, commonality with existing systems is virtually nil. For example, consider the recent acquisitions of the A-10, F-14, F-15, F-16, and F-18—all of which came into the inventory at roughly the same time. There is not a common piece of intermediate level test equipment among these fighters!

A common jest among the using command logisticians is "the airplane itself is cheap and easy, but the support equipment and testers—that's where the big bucks and real showstoppers are." This should come as no real surprise if you consider that:

a. Approximately 60% to 80% of total life cycle cost is expended during the operation and support phase of a weapon system.

b. Approximately 85% of all logistics decisions have effectively been "locked in" by acquisition Milestone II, either by logisticians or by design engineers who may or may not know the logistical impact of their design decisions.

c. High performance systems are usually more expensive and difficult to support than their predecessors. (2:14)

Each of these new weapon systems is on the leading edge of performance technologies, but logistics support has not evolved at the same rate. Thus, we field the latest state-of-the-art high technology fighter aircraft supported by a "highly industrialized, relatively immobile, and manpower-and-equipment intensive logistical infrastructure."(3:1) Until this changes, no real increase in supportability for *any* new concept will occur.

With the increased emphasis on reliability and maintainability, the new advanced tactical fighter (ATF) may be the first weapon system to make significant inroads toward striking a balance between high performance and reliability and maintainability. But we should do even more.

A New Approach

We should not wait for the ATF to bring our visions to reality. The in-use weapon systems of *today* must be made more reliable and maintainable. This can be done by modifying installed aircraft equipment and the test equipment that troubleshoots and repairs this equipment.

Studies by Northrop Corporation revealed that approximately 28% of all aircraft failures are attributable to maintenance errors, foreign object damage, or abuse. The remaining 72% are "equipment-inherent"—resulting from design compromises, deficiencies in technology and manufacturing, or improper instructions for repair and maintenance. (1:14)

Contractors had plenty of help, however, in getting to this stage. Defense Department requests for proposals have historically emphasized system performance. Many times performance was the driving factor no matter what the cost. It is crucial that we redress this imbalance! If we were able to realize a 50% reduction in the aforementioned percentages (28% and 72%), that would equate to an overall 50% increase in reliability and maintainability. Modifying *existing* fleets could be done "at a fraction of the cost of buying more less reliable aircraft while significantly increasing the number currently on hand to prosecute the air war." (1:12)

Thomas V. Jones, writing in the *Defense Management Journal,* went on to explain the significance of this point:

> While the presence of a particular level of force is important, it is the persistent application of that force that will make the difference between victory and defeat. Such persistence is simply impossible if aircraft are unreliable. (1:12)

As a first step, the Air Force Systems Command should be given the charter to proceed with modifying the newest aircraft they have delivered to us (F-15 and F-16) to provide a 50% increase in maintainability and reliability in the high failure systems of these aircraft. It *can* be done. The new F-20 advertises an initial mission reliability rate of 98% based upon 300 flights. (1:15) Northrop secured firm contractual commitments to reliability from its component suppliers. For example, the mission computer calls for an operational meantime between failure (MTBF) rate of 2,100 hours, the head-ups display 3,600 hours, radar 4,000 hours, and the inertial navigation system 2,000 hours. (1:15) We could do the same with contracts to modify our existing fighter fleet.

The second step is to develop new, or modify existing, test equipment. Avionics intermediate sets provide one example. The F-15 and F-16 each have their own AIS. Neither is compatible with the other and, without it, the repair of black boxes comes to a halt. Even with a fully operational AIS, today's front-line fighters are still liable to be queued up waiting for a black box to be run across the test bench. That is after the suspected box has been removed and transported to the AIS for checkout. Once fixed, the reverse process must take place before an aircraft is fully mission capable.

We can prevent such scenarios from damaging combat capability. Consider the following:

> Allen Puckett, Chairman and Chief Executive Officer of Hughes Aircraft, has formulated "Puckett's Law" to describe the impact of advances in microelectronics technology on systems design. According to that law, technological growth has been so rapid and so profound that a designer of electronic equipment can improve a specified design each year by a factor of nearly two over the previous year; that for a given cost and performance, weight can be reduced by a factor of two; that for a given weight and cost, performance can be increased by a factor of two; and that for a given cost, weight, and capability, reliability can be increased by a factor of two. (1:14-15)

General Electric's new F404-400 engine proves Puckett's point. In the same thrust class as the old workhorse J-79, the F404 has 7,700 fewer parts and weighs one-half as much. The F-18 has 8,000 fewer parts than the Navy F-4J. (1:15) As another example, consider the F-20 radar:

> The radar is an especially interesting case. Herb Kindl, General Manager of General Electric's Aircraft Equipment Division, testified to the truth of Puckett's Law at the unveiling of the F-20's radar in late 1982 when he said, "Not quite 20 years ago, G.E. developed the F-111 attack radar. From a functional standpoint, the F-111 radar contained about 2,500 active elements. The F-20 contains over 15 million active elements, or an increase in functionality of 6,000 times. If we had to produce the performance of the F-20 radar with 1965 technology, it would require 500 boxes instead of seven. It would weigh 25,000 pounds instead of 270. It would consume 300,000 watts of power instead of 300. And the resulting radar would only have a meantime between failure of 52 minutes instead of the 200 hours." (1:15)

The point is that refinements are continually made to the "tip of the spear," but the refinements necessary to keep the tip finely honed and sharp often lag years behind. This imbalance in today's support equipment for high-tech fighters needs to be corrected. By applying the latest technologies available to updating, and truly modernizing our support

TO 31 ▷

Airmen, Combat, and Tactical Fighters

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Paradox: The Air Force wants fighter squadrons to be independent from a doctrinal standpoint, but does not often permit them to operate that way.

Tactical fighter units are unique organizations requiring dual personalities. They must closely resemble industrial organizations and are thus subject to traditional economic measures of efficiency. On the other hand, they are combat organizations which must be prepared to absorb attacks by enemy forces and still continue to function. A critical policy problem is the selection of organizational structures for tactical air force (TAF) units which successfully balance the rational desire for economic efficiency with the categorical necessity for combat effectiveness. To further complicate the dilemma, this must be done in the face of known resource constraints and hard-to-define enemy threats.

Doctrine Versus Organization

Fighter aircraft are organized on a wing basis. A wing is nominally composed of 72 aircraft, divided into three squadrons of 24 fighters each. These aircraft are supported by three types of maintenance squadrons, a supply squadron, a transportation squadron, a civil engineering squadron, a security police squadron, and various other base housekeeping organizations. The commanders of each subordinate squadron ultimately respond to one person, the wing commander.

Some would argue, though, that the flying *squadron*, rather than the *wing*, is the fundamental fighting unit. However, this can be true only when the squadron is detached from the wing and provided with the maintenance personnel and other types of manpower necessary for autonomous operations. On a conventionally organized main operating base, only the *wing* commander holds all the strings.

Herein lies a paradox: The Air Force wants fighter squadrons to be independent from a doctrinal standpoint, but does not permit them to operate that way in peacetime except for brief deployments, during exercises, and at certain isolated overseas sites.

Why does the incongruity between the combat requirement for independent squadron operations and the organizational reality of centralized maintenance support exist? The answer is multifaceted. First, independent squadron operation is not a universal requirement. Centralized maintenance is well suited to flying units with no mobility requirements, such as Air Training Command (ATC) wings. It also seems to work well with Strategic Air Command (SAC) bombardment wings which are characterized by small numbers of aircraft. Second, there has been a strong organizational bias toward standardization; the bureaucracy traditionally preferred a SAC unit to look like a TAC unit, and a MAC unit, and an ATC unit. It has preferred for them to work out of the same manuals and indeed to use the same people, theoretically interchangeable among commands without loss of efficiency. Third, the numbers of direct labor maintenance people are justified by a simulation model which ignores the possibility that people can behave differently under different organizational structures. In response to recurring pressure from the fighter community, the Air Force has come at least part way (with the TAF's Combat Oriented Maintenance Organization) in recognizing the need for organizational differences between commands, but has stopped short of fully integrating operations and maintenance at the squadron level.

A View of People

The author believes an important element is missing from the organizational equation—recognition of the human element in combat maintenance and its impact on organizational design. Irving Janis and Leon Mann, in *Decision Making: A Psychological Analysis of Conflict, Choice and Commitment,* see a person:

> not as a cold fish but as a warm-blooded mammal, not as a rational calculator always ready to work out the best solution but as a reluctant decision maker—beset by conflict, doubts, and worry, struggling with incongruous longings, antipathies, and loyalties, and seeking relief by procrastinating, rationalizing, or denying responsibility for his own choices.[1]

The import of this view is that models of the type used by the Air Force for manpower calculations do not fully capture those flesh and blood attributes that make a difference in performance. In their best-selling work, *In Search of Excellence: Lessons from America's Best-Run Companies*. T. J. Peters and R. H. Waterman, Jr., make a compelling argument that the type of "rational analysis" that is "missing all of that messy human stuff . . ." is in the long run in error even from an industrial efficiency viewpoint.[2] That argument can be reinforced in light of what is known about a human's reactions to the stress of combat.

The Problem

Consider an Aircraft Generation Squadron (AGS). This is the maintenance squadron responsible for the launch and recovery of sorties, the on-aircraft corrective maintenance of broken aircraft, and the servicing of fighters. In large wings

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this unit contains over 600 people. One commander—600 troops. When individual fighter squadrons deploy, the AGS fragments along designated lines to provide support.

James P. Kahan and others from The Rand Corporation recently conducted a review of literature relating individual characteristics to unit performance. Two of their findings seem especially relevant to the question at hand. First, they found there is clear evidence that group cohesiveness, or a common orientation toward task productivity, is associated with superior performance. Second, feedback on performance—both on individual and group levels and in the form of information about specific behavioral segments—improves performance.[3] To the Air Force, this could be interpreted as meaning organizations more conducive to group cohesiveness may be superior to those less so, and we should train as we expect to fight so as to provide relevant feedback.

"Is fragmenting a unit just prior to combat deployment a reasonable method of fostering cohesiveness?"

Is an organization of 600 people conducive to group cohesiveness? Is fragmenting a unit just prior to combat deployment a reasonable method of fostering cohesiveness? Do we train as we intend to fight? I believe that the answer to each of these questions is "No."

Change: Difficult But Critical

Why haven't these deficiencies led to a universal demand for change within the maintenance community? The TAF has been in a centralized mode for around 20 years, having fought a war in Vietnam supported with centralized fighter maintenance. In the Vietnam case, though, this was appropriate since sortie generation was largely in the "bomber mode"—long sorties, few turnarounds. Also, there is an illusion among maintenance officers that, by having an organizational separation from the "pilot side of the house," they will somehow improve their chances for high-level promotion vis-a-vis the pilots. Of course, it has not worked out that way, since approximately 79% of current USAF general officers are rated.

Maintenance is not the only area affected by this modular concept. Current security police mobility doctrine also fragments operating units and deploys the various elements and subunits to different locations. For example, a security police squadron may be tasked to provide 100 personnel for mobility requirements who are grouped into four various team compositions and tasked to deploy to four different locations. Fragmenting these units can destroy unit cohesion and the high levels of mission proficiency that the units have developed by training together at their home stations. Experience by one of the authors in Grenada indicates that grouping these fragmented units in a deployment scenario can be characterized by chaos, unclear command and control, hasty planning, and inefficient implementation of defensive operations.

Air Threat

But, as important as the aforementioned reasons may be, they pale in importance next to the key concern of this paper—the potential disruption to the sortie generation process by enemy attacks on US air bases and the likely reactions of individuals to the stress of warfare. With the significant exceptions of the raids associated with Pearl Harbor and the Philippine Islands and the successful Luftwaffe pursuit of the first "shuttle" bombing raid during World War II, the US Air Force has been largely immune from other than harassing attacks directed at its air bases. In contrast, the Navy had to protect its bases, the carriers, throughout World War II. The Navy has long placed carrier protection near the top of mission priorities and has trained personnel to accomplish this protection and to cope with the consequences should the defense prove less than perfect. The Air Force has begun to take progressive steps with the hardening of bases, the training of rapid runway repair teams, the formation of the Air Base Survivability Program Office, and the benchmark air base survivability exercise SALTY DEMO. However, one gets the impression that, although acknowledged as potentially serious, base attack has been perceived mostly as a temporary interruption in the routine process of generating combat sorties.

"The magnitude and uncertain nature of these threats may require that wings be capable of operating in smaller groups at austere sites for short periods during the initial phases of combat."

Gordon W. Prange, in *At Dawn We Slept,* credits the Japanese with delivering approximately 132,000 kilograms of ordnance during the Pearl Harbor attack.[4] It is not unlikely that NATO air bases will receive attacks of at least regimental size from Warsaw Pact forces. A single regiment of 36 Flogger Ds conservatively loaded with 8 FAB-250 general purpose bombs is capable of delivering 72,000 kilograms of ordnance itself. This portends attacks of massive proportions. Complications would multiply in the face of mines, random explosions of delayed action weapons, chemicals, and the possibility of SPETsNAZ operations in conjunction with attacks from the air. The magnitude and uncertain nature of these threats may require that wings be capable of operating in smaller groups at austere sites for short periods during the initial phases of combat.

Ground Threat

In the past our air bases have normally had several layers of direct and indirect protection from ground attack. First, the geographical location of our air bases with respect to the front line or forward edge of the battle area (FEBA) afforded our installations some degree of protection. Second, the outer perimeters of our air bases were defended by Army personnel and resources, while our own ground forces protected the inner areas. However, technological advances in weapons, munitions, communications, and intelligence systems have significantly reduced the protection afforded by the geographical location of our air bases. Additionally, modern force ratios and budgetary constraints have forced the Army to withdraw its support from our air bases and move these forces closer to the FEBA. Consequently, the responsibility for the defense of our outer perimeters has been shifted to the Air Force. (Doctrine is actually in a state of considerable flux on this issue.) In order to effectively defend our air bases in a combat environment, we need to understand the types of

threats we will face from opposing forces. It can be assumed that opposing forces will likely use tactics, organizations, and equipment supplied by or patterned after the Soviet Union. Soviet tactical doctrine uses the principles of offense, mass, and speed supplemented by economy of force. Basically, threat strategy emphasizes that victory is gained by moving fast, in large numbers, and striking quickly to destroy the opponent's forces and not by seizing and holding terrain. Threat forces defend only in the face of a stronger opponent and only long enough to concentrate forces and regain the initiative. To facilitate their offensive operations, Soviet doctrine relies heavily upon rear area combat forces whose objective is to disrupt rear area operations, forcing their opponents to fight a two-front war. In any future conflict, airpower's speed, flexibility, and firepower could be the decisive force in defeating major offensive operations by threat forces and this factor will make our air bases key targets for our enemy.

According to AFR 206-2, *Ground Defense of Main Operating Bases, Installations, and Activities,* attacks that could be postulated against our air bases can be divided into three threat levels:

(1) *Threat Level I* is considered a peacetime threat that increases in frequency prior to the initiation of open hostilities. This level is characterized by intelligence collection, sabotage, and attacks to disrupt lines of communication and delay military preparations. These activities are usually carried out by enemy agents, sympathizers, partisans, and terrorist organizations.

(2) *Threat Level II* activities include long-range reconnaissance and sabotage operations conducted by special operation forces (SOF) similar to the Soviet SPETsNAZ or the North Korean Commando Rangers. (The Soviets are thought to have 16 brigades of SPETsNAZ while North Korea has 22 Special Operations brigades.) This type of force can be airdropped, airlanded, or infiltrated by land or sea and is usually armed with light automatic weapons, small antitank weapons, portable surface-to-air missiles, and numerous explosive devices. They can also be dropped in company or larger size units in order to destroy key rear area targets such as air bases.

(3) *Threat Level III* is characterized by major offensive operations by conventional airborne, airmobile, airlanded, and/or naval infantry forces. The viable threat from conventional airborne forces is reflected in AFR 206-2 when it points out that, "Depending upon the adversary, airborne units of up to division size could be dropped up to 320 kilometers (km) beyond the front line."[5]

"If we are going to be responsible and successful in defeating ground attacks against our air bases, then we ought to start thinking, training, and fighting as soldiers in addition to being professional airmen."

Unfortunately, under today's deployment procedures, there is no coordination between Security Police and other personnel who will arrive at a deployment location armed with M-16s. Currently, each skill area tasked with mobility (security police, civil engineers, aircraft maintenance, etc.) is conducting its own wartime skills training. Training is not being conducted which interfaces the various skill areas and their coordinated efforts during an enemy attack. For example, if an air base is under a large-scale attack from a company size or larger force, the survivability of that installation will be dependent upon its forces who are armed with weapons and not just the security police ground defense units. However, since most of these units (or skill areas) have never trained together, the chaos, stress, and uncertainty of combat are likely to produce confusion that will only facilitate a decisive engagement in favor of the opposing forces. In order to defeat the Soviet strategy, all forces will have to fight together as a single integrated unit. This notion runs parallel to the Army's concept, "An individual is first a soldier, and then a cook, supply specialist, etc." If we are going to be responsible and successful in defeating ground attacks against our air bases, then we ought to start thinking, training, and fighting as soldiers in addition to being professional airmen.

On the positive side, it is not difficult to find examples of units which have survived attacks and performed well despite their losses. The German Battle Group von Luck of Normandy fame is a good example. However, these have usually been *combat* units—organized, trained, and conditioned to operate under fire. In such units there is a culture of combat neither fostered nor present at US air bases. Though perhaps somewhat unfair to overseas bases, this criticism clearly applies to stateside locations, and it is precisely these CONUS units that will be required to deploy and operate independently in wartime.

Morris Janowitz points out that:

> Military Managers . . . are aware that they direct combat organizations. They consider themselves to be brave men, prepared to face danger. But they are mainly concerned with the most rational and economic ways of winning wars or avoiding them. They are less concerned with war as a way of life.[6]

Structure Is Important

Canadian Anthony Kellett's recent work, *Combat Motivation: The Behavior of Soldiers in Battle,* explores the factors which affect combat performance. His findings include the following conclusions:

> . . . by the Second World War the basic group in an infantry regiment had become the section or squad . . . an American psychiatrist (Hanson 1951) noted ". . . that after the squad, the company . . . was the major psychological group because of its relative administrative, tactical, and disciplinary self-containment . . . groups of five tend to be psychologically the most solid and especially useful, therefore, in fluid guerrilla situations." David Chester, of the U.S. Army's personnel research branch, found that in Korea morale was highest when men were trained in groups of four and when these groups were kept together at all times. . . .[7]

The key element is that effectiveness under the stress of combat is fostered by the cohesion of small groups of people organized into small units (a company numbers in the 150-300 range). Interestingly, the same phenomenon is noted in management literature. Peters and Waterman refer to "chunking," i.e., breaking up problems into more manageable units, and contend that the optimal group size to attack such problems is about seven.

But why is all this necessary? Airmen know their duty. Why can't we assume they will by and large just follow it regardless of organizational and psychological factors? S.L.A. Marshall, neither an organizational development specialist nor a psychologist, but rather a student of men in battle, explains it

well in his classic work, *Men Against Fire:*

> In the normal man it is an absolutely normal impulse to move away from danger. Yet it is recognized by all that personal flight from danger, where it involves dereliction of duty, is the final act of cowardice and of dishonor. During combat the soldier may become so gripped by fear that most of his thought is directed toward escape. But if he is serving among men whom he has known for a long period or whose judgement of him counts for any reason, he will strive to hide his terror from them. . . . It is therefore to be noted as a principle that, all other things being equal, the tactical unity of men working together in combat will be in the ratio of their knowledge and sympathetic understanding of each other. . . . But having noted the principle, it should be noted further that it is honored . . . more in the breach than in the observance. . . . We have never had any continuity of policy which should be based upon the simple idea that esprit de corps depends upon comradeship and our changing policies too frequently reflect an obliviousness to the factors which compose the moral strength of fighting forces.[8]

"Fighter squadrons should have enough maintenance capability organic to the unit to permit independent operation for at least short periods."

Meshing Theory and Practice

This article presents three basic notions: Future combat environments may require operations in small units under fire, people react better under stress when they are integrated with the unit with which they are fighting, and these factors do not lend themselves to the exclusive use of economic models to evaluate organizations. The meshing of these ideas leads to the following prescriptions:

- Air Force leaders must require the exercise of more judgement in the use of economic models as tools. It is not a question of either models or military judgement, but rather of how to best integrate the power of both to arrive at better decisions.
- Fighter squadrons should have enough maintenance capability organic to the unit to permit independent operation for at least short periods.
- Such a newly endowed squadron and its supporting elements should further be organized into subunits having permanently assigned personnel who will both train and fight as a team.

Of course, none of this would be new to the Air Force; it has all been done before. Such changes would be more like a return to normalcy than a radical departure from policy.

Evolution of the Current Support Organization

During the early years of the Air Force, the basic unit of organization was the flying squadron. Integral to that squadron were all the maintenance personnel necessary to perform all the on-aircraft tasks necessary to generate sorties. Component repair, engine maintenance, and most of the supply and the housekeeping functions were in other squadrons. The wing commander was of course ultimately responsible and all organizations were required to answer to him. However, the "ownership" of key maintenance assets by the flying *squadron* commander gave that commander independence, responsibility, and authority many times that of his present day counterpart.

During the late 1950s and early 1960s, at least two forces altered the squadron orientation of the Air Force. First, the emphasis was on SAC. This meant an organization which was geared primarily to a single spasmodic launch in wartime and, from the perspective of a modern day fighter unit, a light peacetime flying schedule—long sorties with few if any turnarounds. Centralized maintenance worked fine (and still does) for organizations with such characteristics. Under NATO Military Committee Document 14/2, fighters were also oriented toward the tripwire strategy so they could fit well into the SAC mold. Since SAC meant standardization if it meant anything, and Air Force leadership was provided by a succession of SAC commanders, a natural flow occurred toward the SAC mode of operation. Second, this trend was reinforced by budget pressures and rapid implementation of analytic techniques based fundamentally on economic analysis. Secretary of Defense MacNamara and his "whiz kids," supported by a large body of analysis carried out by organizations such as Rand, became noted for focusing on numbers. This resulted, whether unintentionally or by design, in the almost total exclusion of considerations of human emotions and motivation in circumstances where they clearly play a significant role. Growing from this era was a powerful computer simulation model known as the Logistics Composite Model (LCOM) which became the fundamental tool for direct maintenance manpower determination in the TAF. While LCOM, along with its heir apparent Theater Simulation of Airbase Resources (TSAR), is valuable for many purposes, their implementation in the area of manpower utilization suffers from a blindness to individual skill level and motivation which can lead to fallacious analysis. In the author's opinion, manpower determination has been in the grip of economies of scale derived from analysis using a model devoid of any possible tradeoffs other than first order economic ones and reinforced by budget-conscious leadership only too happy to believe its typically over-optimistic answers.

Notes

[1]Janis, Irving and Leon Mann. *Decision Making: A Psychological Analysis of Conflict, Choice, and Commitment*, The Free Press 77.

[2]Peters, Thomas J. and Robert H. Waterman Jr. *In Search of Excellence: Lessons from America's Best-Run Companies*, Harper and Row, New York, 1982.

[3]Kahan, James P., et al. "Individual Characteristics and Unit Performance: A Review of Research and Methods," The Rand Corporation, R-3194-MIL, February 1985.

[4]Prange, Gordon W. *At Dawn We Slept: The Untold Story of Pearl Harbor*, McGraw-Hill Book Company, 1981.

[5]AFR 206-2, *Ground Defense of Main Operating Bases, Installations, and Activities*, Headquarters US Air Force, Washington, D.C. 22 September 1983/*Air Force Magazine*, "The Military Balance," February 1986.

[6]Janowitz, Morris. *The Professional Soldier: A Social and Political Portrait*, The Free Press, New York, 1960.

[7]Kellett, Anthony. *Combat Motivation: The Behavior of Soldiers in Battle*, Kluwer-Nijhoff Publishing, Boston, The Hague, London, 1983.

[8]Marshall, S.L.A. *Men Against Fire: The Problem of Battle Command in Future War*, Peter Smith, Gloucester, Massachusetts, 1978.

"There is only one sound way to conduct war as I read history: Deploy to the war zone as quickly as possible sufficient forces to end it at the earliest possible moment. Anything less is a gift to the other side."

S.L.A. Marshall

PACER SORT: A Test of Logistics in Vietnam

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There is no exact date for the completion of the base buildup program in Southeast Asia (SEA), but by 1967 the US Air Force (USAF) could look back on a tremendous amount of work completed in an amazingly short time. Just a few years earlier, before the buildup started and before the decision was made to deploy tactical units on a permanent basis and engage them officially and directly in combat, the Air Force had next to nothing in Vietnam. It had no bases of its own, and those few it shared with the Vietnamese Air Force were primitive by USAF standards. Only three bases in South Vietnam had jet runways, and none had the facilities to which the USAF was accustomed. At the start of the buildup, when tactical forces were deployed to Vietnam rapidly and in large numbers, most "facilities" consisted of tent cities and open-air work areas carved out of jungles or beaches. So the question, then and later, was how to accommodate and support the huge influx.[1]

Doctrines and Basing Strategies

The USAF's initial approach to this problem was more a temporary expedient than a real solution. Off the Asian mainland, six major bases, known as main operating bases (MOB), supported a handful of forward operating bases (FOB) in South Vietnam. While the maintenance and supply capabilities of the forward bases were strictly limited, such bases at least could be quickly constructed and easily operated. For their part, the main bases, with their large depots, extensive facilities, and heavy support equipment, provided a wide range of services outside the combat zone and yet not so far away as the continental United States. Such were the advantages, in theory, of the "MOB/FOB system," but they were not calculated advantages. The Air Force had seized upon this arrangement out of necessity—it was the only one available at the time—and just as quickly grew dissatisfied with it.[2]

There were several reasons for dissatisfaction with the MOB/FOB system. For one thing, the system was inefficient. The FOBs were in fact too limited in their maintenance capabilities, the MOBs were actually quite a long way from the Asian mainland, and too much operational time was lost transferring aircraft back and forth for repair, with the result that the NORS (Not Operationally Ready, Supply) rates were excessively high. Then, too, the concept of having forward bases dependent on rear area main bases was contrary to long-standing USAF logistical doctrine. This doctrine, developed in the 1950s, was based on a strategy of massive retaliation in a short, intense nuclear war. Then, as now, readiness was the watchword of the day. But since there could be no mobilization after a nuclear war, this meant in the context of the times that each base had to be fully prepared to do its part at the critical moment, which is to say that each base had to be fully developed and logistically self-sufficient. As a corollary to this premise, the Air Force had phased out its intermediate size overseas depots, which were vulnerable in war and of no use to self-sufficient bases.[3]

Before the buildup—Pierced steel planking is off-loaded from a C-123 at Aloui airstrip, South Vietnam. At this point, airfields needed to handle only rugged propellor-driven aircraft, primarily T-28s, A-1s, and B-26s.

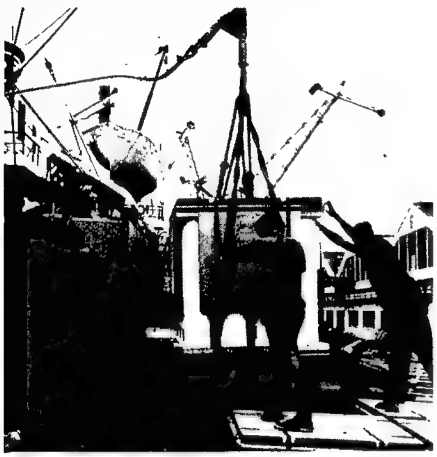
By the early 1960s, the policy of base self-sufficiency had become firmly entrenched doctrine—stressed in official pronouncements, recorded in regulations, and tenaciously applied everywhere. It was hardly surprising that, in 1965, when the USAF ran into trouble with the MOB/FOB system in Southeast Asia, the first thought of the tactical and logistical leaders was to build up the forward bases to the point they became self-sufficient. In effect, the USAF had chosen to discard the MOB/FOB system by turning the forward bases into MOBs, a decision that opened the way for an enormous amount of logistical activity.[4]

Forward-Based Self-Sufficiency

The accomplishments of Air Force logisticians are impressive by any measure. Within just a few years from the start of the buildup, they had established major bases on the mainland, and in the process had constructed jet runways, air-conditioned maintenance facilities, communications centers, modern depots, hospitals, roads, and bridges. Thousands of miles separated the new bases from all the equipment needed to run them, and procuring and shipping that equipment rapidly under Project Bitterwine demanded a heroic effort. Logisticians made that effort and, when their work was completed, they had supplied more than a score of bases with over $80 million in equipment.[5]

But for all their hard work—and partly because of it—logistics problems piled up. The USAF's movement into Southeast Asia was a dynamic process of unit deployments, base construction, and the shipment of materiel. Since these actions were often carried on simultaneously, much of the Bitterwine materiel arrived with no place to put it, except on

the beaches, where finding particular items was more a matter of luck than of logistics. An even worse problem was caused by the nature of the Bitterwine system itself—a system that bypassed standard requisitioning procedures and "pushed" supplies to their overseas destinations. Perhaps there was no other way to rush a huge volume of equipment to rapidly deploying forces, but the result nonetheless was a breakdown of the distribution system. In some cases, supplies never reached their intended bases, while other bases received far more than they required, and that in turn created the often embarrassing problem of excess materiel.[6]



Rocket launchers being transferred from a freighter to trucks upon arrival in Southeast Asia in 1966. In order to speed shipment, many munitions-related items such as these, flares, and bomb fuzes were diverted to air shipment direct from Hill AFB under Project SEAIR.

One emergency action led to another. In the wake of Bitterwine, the Air Force Logistics Command (AFLC) dispatched special teams to Southeast Asia to help redistribute supplies and equipment, and other teams to help in other logistical matters. These measures were effective, but they did not solve the basic problem confronting the logisticians in Vietnam. That problem, logisticians later pointed out, was "the continual changing of the operational program." Fighter wings frequently changed bases while supplies were in transit to a particular destination and, as a result, materiel all too often arrived where it was not needed.[7]

This was not a complaint, but rather a frank admission that the logistical system itself had not been flexible enough to keep up with operational requirements. It was also an expression of frustration and concern that dated almost from the start of the buildup, intensified as the buildup proceeded, and was shared by all elements of the acquisition and logistics community. For even as they were doing everything in their power to build up the bases, logisticians began to perceive that this was the wrong policy for the war at hand—concentration of resources in the forward areas was restricting mobility of the tactical forces, and logistical considerations were dictating the terms of operations. They did not see this all at once but, by June 1965, the AFLC had seen enough to warn HQ USAF that the logistics system was not working effectively in Southeast Asia. AFLC actions thus far, the Command advised, often amounted to putting "patches" on a logistical system that "was not designed to support a sustained, conventional war," and there was no assurance that these patches would last indefinitely. The time had come, AFLC concluded, for "a complete 'new look' at logistics concepts as they relate to tactical forces support."[8]

Optimum Base Repair Concept

The Logistics Working Group of the USAF's Scientific Advisory Board had recently come to the same conclusion, and AFLC had already undertaken a long-term study of the base self-sufficiency concept. This study, which lasted well into 1966, confirmed what AFLC already suspected—that a logistical system designed in the 1950s for peacetime forces located at fixed bases was not the best method of supporting tactical forces in Vietnam. This was not to say that base self-sufficiency was the worst policy, or even that it was detrimental (although the implication was clear enough). In the minds of AFLC leaders, however, there was no question that they could devise a much better method of support, one they called "optimum base repair." That term was no euphemism for "minimum," but designated instead a concept of tailoring support capabilities according to operational requirements and a carefully planned division of workload between the bases in the war zone and depots in the United States. Nevertheless, while the new policy did not necessarily call for minimal base support capabilities, its intent was to place more of the workload on AFLC's depots, reduce the logistical resources in Vietnam, and thereby increase the mobility of the tactical unit.[9]

AFLC had enough confidence in the wisdom of the proposed change to begin carrying it out in June 1966, but only indirectly and without the force of regulatory authority. Even before the study was officially completed, the AFLC Vice Commander, Lieutenant General Lewis L. Mundell, instructed his field units to "refrain from use of the term 'maximum base self-sufficiency' for guidance and in detailed application of its implications." Meanwhile, the AFLC Commander, General Kenneth B. Hobson, enlisted the support of the Commander of the Air Force Systems Command, General Bernard A. Schriever, and together the two Commanders decided to carry on the AFLC study under the aegis of a joint panel, presumably a more influential forum for presenting their views.[10]

The panel completed its work in short order and, on 7 July 1966, General Hobson presented the results to the Chief of Staff of the Air Force, General John P. McConnell, who fully agreed with the proposed change in base logistical capabilities. But as General Hobson also observed at this meeting, the proposal, no matter how sound it appeared, was only theoretical until put to the test. "The proof of the pudding," the AFLC Commander summed up, "will stem from realistic testing of the total logistics system in war games, exercises,

Cam Ranh Bay AB—An open storage area operated by MAC in 1967.

rotation situations, and wherever it occurs, in sustained deployment situations—such as the present Southeast Asia operation." The Chief of Staff agreed that a test was necessary and that Southeast Asia was the place to conduct it, whereupon AFLC proceeded to draw up a test plan.[11]

Testing A New Concept

The plan developed by AFLC over the next several months was called "PACER SORT," the latter word being an acronym for "Specialized Overseas Repair Test." The aircraft to be examined under this project was the F-4, the most modern fighter then in the tactical fleet. For a test site, AFLC selected the big F-4C base at Cam Ranh Bay. There, a 70-man team from AFLC, led by Major General William W. Veal, would spend almost four months studying field maintenance for the F-4 and the resources required to perform that maintenance. Since the basic purpose of the test was to compare two different concepts of logistics, General Veal proposed to divide the F-4C squadrons into two groups, one to be maintained under the existing procedures of maximum base repair, the other under the optimum base repair method. As a secondary objective, the test team would also look for ways to improve supply support to deployed tactical units.[12]

Headquarters USAF approved this plan, after it had been coordinated with the Pacific Air Forces, but did not issue Test Order 66-27 until January 1967—most likely because testing a basic logistical concept was not the first priority in war. (One of the overriding considerations in the development and approval of the plan was that the test not interfere with operations.) But once the test order was issued, AFLC lost no time in dispatching General Veal's team to Cam Ranh Bay. Although the first four weeks of effort yielded incomplete and unreliable data that had to be discarded, the team collected enough information by May 1967 to issue a preliminary report, and by June a final report. Technically, PACER SORT would continue as a project for another six months, until certain collateral studies had been completed; but these did not directly bear on the central question, and by June 1967 the verdict was in.[13]

The results were mixed, and at first glance even disappointing. As General Hobson frankly acknowledged, AFLC had expected to find that the policy of maximum self-sufficiency committed a large number of personnel to the repair function. That was not the case. In fact, AFLC concluded that—with respect to component repair on the F-4—the potential for manpower reductions was "minimal." But this was only one result of the test and, though surprising, it was hardly the most significant. The other results, while not surprising in view of AFLC's earlier assumptions, were so significant that General Hobson immediately brought them to the attention of his field commanders in the form of a major policy announcement.[14]

From the vantage point of the AFLC Commander, there were several lessons to be learned from PACER SORT. For one thing, the test had confirmed AFLC's supposition that expensive aerospace ground equipment was overly complex and underutilized at the tactical bases. And on the home front, it had to be admitted that AFLC's depots did not provide the range of services the tactical units would require if they did not have maximum base self-sufficiency. The test had even provided AFLC with valuable experience in data collection and evaluation that could help make future logistical planning more precise and hence more effective. But all these lessons really pointed in the same direction—toward the need to simplify the mechanisms of support to Southeast Asia. "We must do everything possible," General Hobson told his commanders, "to simplify the total system. The supply difficulties experienced at Cam Ranh Air Base and between the base and AFLC clearly indicate that present systems are too complex, too sophisticated, and generally incompatible with the inherent simplicity of support for mobile flexible forces."[15]

Simplifying "the total system" was a large order and one that could not possibly be accomplished overnight, especially in the midst of war. When General Hobson called for the simplification of support, he was asking, among other things, that weapons be designed with maintenance in mind, so logistics on the battlefield could be kept to a minimum. Logisticians would still be raising that question twenty years later. But even if larger issues remained unresolved, PACER SORT had at least given logisticians the chance to see how their systems really functioned in war. They were surprised to find that "the system concepts, as envisioned by the designers and managers, only approximated the actual operation." The test had also given AFLC enough evidence to change Air Force policy on base-level logistics. When AFR 66-1, then entitled *Equipment Maintenance Policies, Objectives, and Responsibilities,* was revised in January 1969, the new concept of optimum repair had replaced the old doctrine of maximum self-sufficiency.[16]

Notes

[1]Joint Logistics Review Board, *A Review of Logistics Support in the Vietnam Era,* Logistic Support in the Vietnam Era, Vol II, n.d., p. 251 (hereafter cited as JLRB, Vol II); Joint Logistics Review Board, *Maintenance,* Logistic Support in the Vietnam Era, monograph 13, n.d., p. 156 (hereafter cited as JLRB, *Maintenance*).

[2]JLRB, Vol II, pp. 251-252; JLRB, *Maintenance,* p. 158. The six MOBs were positioned at Clark Air Base, Republic of the Philippines; Kadena and Naha, Okinawa; and Tachikawa, Yokota, and Misawa, Japan. In Vietnam, the first three FOBs were located at Bien Hoa, Da Nang, and Tan Son Nhut.

[3]JLRB, *Maintenance,* p. 158; JLRB, Vol II, p. 253; PACER SORT Task Force, HQ AFLC, Project PACER SORT Final Report, Vol I, Part I, II, and III, 30 June 1967, p. I-I-1-1 (hereafter cited as PACER SORT Final Report, Vol I).

[4]JLRB, Vol II, p. 253; JLRB, *Maintenance,* p. 163.

[5]Joint Logistics Review Board, *Construction,* Logistic Support in the Vietnam Era, Monograph 6, n.d., p. 3; W.M. Wilson, HQ AFLC, "Initial Supply Support (Push Packages)," briefing to Joint Logistics Review Board, 30 September 1969, in AFLC Archives (hereafter cited as Initial Supply Support Briefing); JLRB, Vol II, p. 265.

[6]Initial Supply Support Briefing; Bernard J. Termena, *Base Buildup, 1964-1966,* AFLC Support of Forces in Southeast Asia: Supply Support, Vol I, AFLC Historical Study No. 358 (1968), p. 48.

[7]Joint AFLC/AFSC Task Group on Program Management Working Relations, Panel 31, "Repair Level Decisions," briefing on the first phase of base self-sufficiency study, 23 June 1966, in AFLC Archives (hereafter cited as Repair Level Decisions Briefing); Initial Supply Support Briefing.

[8]PACER SORT Final Report, Vol I, p. I-I-8-2.

[9]HQ AFLC, "AFLC Views on Logistics Support of Tactical Forces in the Future," staff paper, ca. May 1966, in AFLC Archives; PACER SORT Final Report, I-I-8-1; Repair Level Decisions Briefing.

[10]Lt Gen Mundell to Oklahoma City Air Materiel Area *et al.,* 16 June 1966, in AFLC Archives; PACER SORT Final Report, Vol 1, p. I-I-8-5.

[11]Gen Hobson to Gen Schriever, 19 Jul 1966, in AFLC Archives; PACER SORT Final Report, Vol I, pp. I-I-8-6, I-I-8-7.

[12]HQ AFLC, "Evaluation Plan: Project 'LOGGY SORT.' " (draft), 13 September 1966, in AFLC Archives; HQ AFLC, Briefing on Project Pacer Sort, n.d., in AFLC Archives (hereafter cited as AFLC PACER SORT Briefing). At this time, "LOGGY" preceded the title of all AFLC projects. Before completion of this project, "PACER" had replaced "LOGGY."

[13]PACER SORT Final Report, Vol I, p. I-I-10-2; AFLC PACER SORT Briefing. A copy of Test Order 66-27 is in the AFLC Archives.

[14]Gen Hobson to Commander, Oklahoma City Air Materiel Area, *et al.,* 19 July 1967, in AFLC Archives.

[15]*Ibid.*

[16]AFLC PACER SORT Briefing.

LOGISTICS WARRIORS

DEALING WITH MUNITIONS SHORTAGES IN SOUTHEAST ASIA

Suddenly in April 1966, several Air Force bases in Vietnam ran out of bombs or critical bomb components. To fill in the deficiencies, Admiral Sharp, Commander of the Pacific Command, on 19 April, ordered transfers of 1,000 250-pound bombs, 1,000 500-pound bombs and 400 1,000-pound bombs from in-country Marine stocks. On 26 April we were ordered to transfer 2,500 more 1,000-pound bombs from Navy assets. By the end of June such transfers from the Navy and Marines, including those to the Vietnamese and Laotian Armed Forces, totaled 41,793. In return, the next two months saw 16,027 ordered transferred to the Navy, mostly 250-pound bombs from Air Force stocks not yet shipped from the continental U.S. Twenty-nine transfers of varying amounts of air munitions were ordered between the Services during the next fiscal year.

There was an urgent meeting at Camp Smith, Admiral Sharp's headquarters, attended by two Assistant Secretaries of Defense, Paul R. Ignatius (Installations and Logistics) and Alain C. Enthoven (Systems Analysis). I presented our forecast of August 1965, the record since then, and predictions for the future. The predictions showed that the low point in many weapons would be reached in about three months, and that, as had been the case before, we could run out of some types if expenditures were not restrained. The knowledge of the location of Navy and Marine usable bombs was complete and up to date.

Mr. Ignatius took aggressive steps to increase production, especially 500-pound bombs. But constructive steps such as these were followed by what I viewed as unfortunate results as well, in the form of new centralized controls. The Secretary of Defense established tight controls and required special reports. For about three months we were required to submit daily reports on the location of each and every complete round of "controlled air munitions." Whether or not this frequency of reporting was necessary, our system handled it, as daily reports from ships and activities, on a usable round basis, were obtained and consolidated at the Service Force headquarters. Later the reporting of assets was relaxed to ten days and then to semi-monthly. New "temporary" ammunition organizations were established in the Office of the Secretary of Defense (OSD), on the Joint Staff of the JCS and on CINCPAC's staff. Our good management continued, but with far more difficulty. In Washington, OSD approvals were to be required for most management actions to do with air ammunitions, including each change in the production schedule, a practice which was later extended to gun ammunition. When the 250- and 500-pound bomb situation improved in the fall of 1966, I requested that "push" shipments of the Mark 81 and Mark 82 weapons stop, and that future shipments be in accordance with our requisitions. It took over a month before permission was obtained.

At the Camp Smith meeting there was evidence that some wanted to extend detailed Washington controls (Joint Staff or OSD) to combat usage and even distribution with the Pacific. Fortunately, Admiral Sharp emphasized his own responsibilities and made it clear what he would do with regard to the control of air munitions. He established monthly expenditure allocations for the Air Force, Navy and Marines, and set up a requirement for forty-five days of "operating stocks" in-theater to guard against emergencies. This was intended, and initially stated, as a minimum goal, but some started treating it as a maximum as well. The Secretary of Defense allowed a 135-day pipeline from the production line, including stocks in Southeast Asia. It was specified that this was not to be exceeded. Although there was logic in some overall controls, as initially applied they created instabilities. Every time there was a change in monthly requirements, or allocations, the change in the authorized pipeline would be magnified (four and a half times for air and five for ship gun munitions) up or down as the case might be. As is always the case involving dynamic systems with time lags—such as in the decision process in production line changes, and in distribution—the overswings would be magnified still further. A more stable policy was finally adopted by the Navy in late 1968.

The preceding discussion should not be interpreted as an intent to be critical of individuals faced with extraordinarily difficult decisions. Rather it is hoped that the discussion will provide insights for those who may encounter similar problems in the future.

Vice Admiral Edwin Hooper, USN (Ret), *Mobility, Support, Endurance: A Story of Naval Operational Logistics in the Vietnam War, 1965-1968.*

SCARY MAINTENANCE PRACTICE

In 1971, I was part of a team from the Air Force Institute of Technology conducting courses in logistics for the Republic of Vietnam Air Force. Our classes were conducted in the RVNAF depot facility at Bien Hoa. I arrived two days before my classes were to begin so I could get acclimated and overcome any jet lag resulting from the crowded MAC charter flight from Travis AFB, California.

On my second day I was walking through the maintenance activities at Bien Hoa because my career in the US Air Force had been spent predominantly in maintenance. I wanted to see how the RVNAF did their work and how they appeared to compare with US efforts. The comparison was scary!

I walked through a shop area of small buildings onto the ramp where a good quantity of maintenance work was underway on a number of aircraft types. I stopped to watch work on an A-1E because there seemed to be so many Vietnamese workers around it. I soon saw why. They seemed not to have any jacking gear, so great numbers of these people gathered under the left wing, on a portable wooden platform, and at some signal all lifted with bowed-back strength until the wing was high enough to slip what looked like a wooden sawhorse under that wing. The sawhorse appeared to be made of dense wood about 6 inches square in cross-section. It was a very heavy device and looked quite strong. Then, again at some signal, all these people, along with others standing by, rushed to the right wing and performed the same lifting event for that wing. Again, a sawhorse was installed. All the people then backed away, and I could see that the wheels were now about an inch off the ground. However, there was no support under the aft fuselage, and it seemed to me the aircraft slightly rocked on its sawhorse support.

Now, the scary part for me! Suddenly, the propeller began to rotate and soon the engine fired and the aircraft, precariously balanced on the sawhorses, vibrated quite rapidly. Now, on signal, the man in the cockpit began gear retraction. Before I hastily departed, the gear had gone up in the well and down again and was starting on its second actuation! I did not stay to see the end of that effort.

I asked some US people about this incident and received a number of disconcerting replies which seemed to indicate the event wasn't all that unusual when the whole of the RVNAF was considered. No one else seemed very concerned.

Jerome G. Peppers, Jr., Professor Emeritus, Logistics Management, SOSL, AFIT.

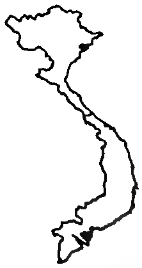
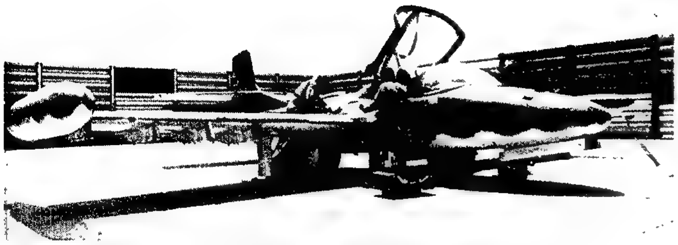


PHOTO SECTION

Logistics in SEA

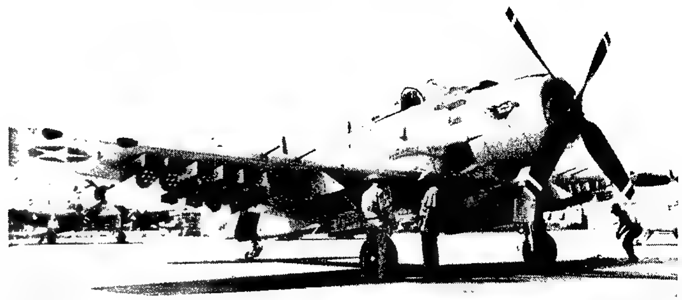
AFJL Editors



Maintainer's Delight—The small size and ready accessibility of all components of the A-37 counterinsurgency aircraft made it an ideal platform for maintenance personnel. Its maintainability, lack of operational complexity, and versatility also made it, along with the A-1, a prime candidate for transfer to the VNAF. This jet is from a squadron of the modified trainers operating in 1967 from Bien Hoa Air Base.

F-4Cs line up for refueling from above-ground bladders at Phu Cat Air Base, 1969.

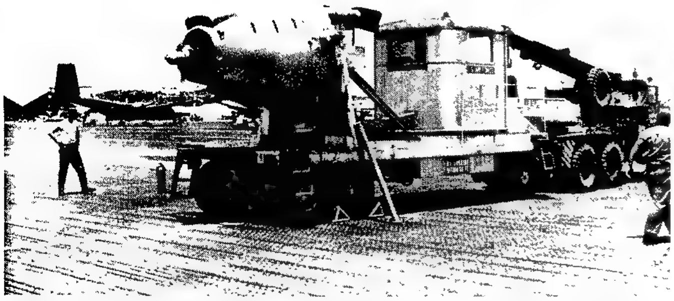
Flying gas station—Rubber bladders containing jet fuel are rapidly unloaded from a C-130 transport onto the dirt landing field at Tay Ninh. Transport of fuel in bladders made it possible to rapidly resupply Army ground units without wasting valuable time unloading barrels. The Army set up tailored support activities at forward airstrips to break down shipments and maintained a 5-day stockage. Brigade task forces could thus be air-resupplied, bypassing divisional depots. This June 1966 delivery supported Operation Birmingham, typical of the joint nature of the search and destroy mission.



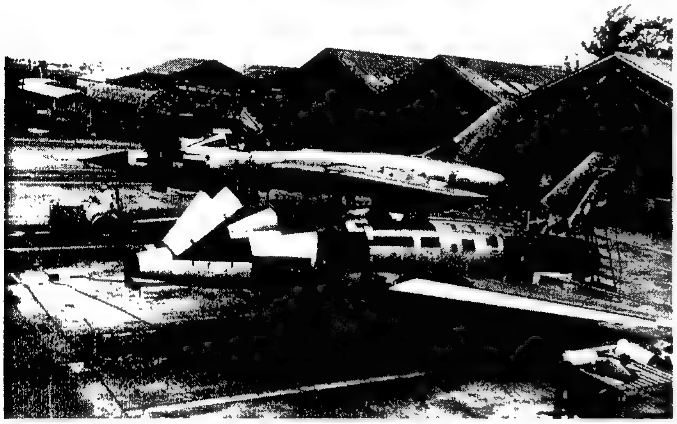
Designed in 1944 for the Navy, Korean-era A-1E Skyraiders served as primary elements early in America's Southeast Asian involvement. TSgt Paul Killibrew, shown here reviewing arming procedures with maintenance NCOIC MSgt Due Huynh Huu, served as aircraft maintenance advisor to the South Vietnamese air arm in 1963.

Maintenance techs of the 90th Tactical Fighter Squadron work on the engine of an F-100 at Bien Hoa Air Base, 1967. As SEA requirements rose, many mods were performed on Supersabre D and F models: updated fire control/weapon release systems; guns and new target-marking gear; an X-band ground-directed night radar bombing system (Combat Skyspot); "Wild Weasel" electronic countermeasures equipment; and AGM-45 Shrike missiles for attacking Fan Song fire control radars. Continual modification—with accompanying in-theater test and evaluation—of older aircraft like the F-100 continually challenged the flexibility and ingenuity of flight-line and back shop maintenance troops.

Line Chief SMSgt John A. Roberts checks the status of RF-4C Phantoms on the maintenance line in April 1967. The mobile radio flight-line expeditor van helped smooth the transfer of status and kept specialists on the move. F/RF-4Cs posted frequent groundings due to dripping potting compound—one maintenance shortcoming that was missed by the 1962 Mockup Review Panel that initiated nearly 150 configuration changes to ease access, servicing, and maintenance.



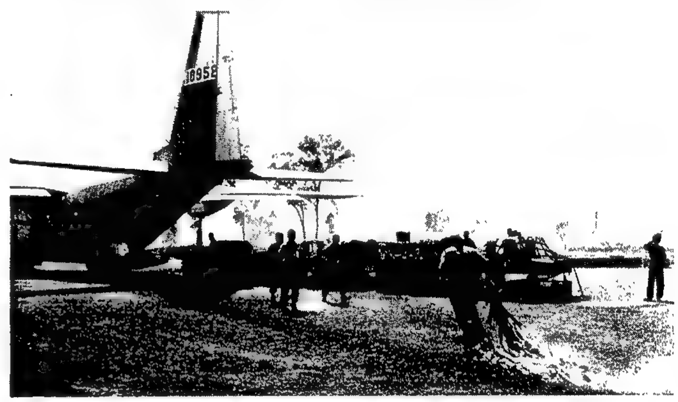
Airmen of the 483rd Troop Carrier Wing run up an overhauled C-7A engine. Heavy (field level) maintenance and supply functions were concentrated at Cam Ranh Bay (shown), with two intermediate units at Phu Cat and Vung Tau and only flight-line (crew chief) sections at the operating bases. Caribous were transferred from Army to USAF in 1967. Serious maintenance problems—a 250,000-hour modification backlog, heavy cannibalization, incomplete documentation, and widespread corrosion—had to be overcome through heavy overtime and AFLC contract assistance before the C-7A could ably perform the rough-field courier and Special Forces support for which it proved well suited.



An F-105 damaged in battle over Vietnam is towed from a maintenance hangar at Tainan Air Station, Taiwan. Many a Thud returned with gaping holes in wings, stabilizers, and fuselage. In 1966, Major William McClelland's Lead Sled took an 85-mm shell in the right 450-gallon fuel tank, which exploded in the pylon and tore out the right wing for over four feet. Despite immense drag, the aircraft flew 500 miles to recover. A surface-to-air missile lodged in the aft section of another Thud, which carried the unwelcome cargo safely home. In the foreground an F-100 Supersabre undergoes repairs for battle damage. Such reconstitution of damaged "Huns" allowed them to fly over 300,000 ground attack, top cap, and forward air control ("fast-mover FAC") sorties in Southeast Asia—a total exceeding that of almost 16,000 P-51s in WW II.

Hazardous profession—Explosive ordnance disposal personnel remove armament from an A-1E Skyraider which crash-landed on the runway at Tan Son Nhut Air Base, March 1966.

Floating Repair Base—The Army's "Navy" helped to get damaged aircraft back in action and, in the process, saved millions of dollars that would have been spent sending aircraft back to the US for repair. Once weekly a Boeing-built Army CH-47A Chinook helicopter flew from An Khe, home of the first floating aircraft maintenance ship, *Corpus Christie Bay*, a Military Sea Transport Service ship equipped to repair all types of Army aircraft flying in Vietnam. Aboard the Chinook are combat damaged parts. Returning to the central highlands, it would carry repaired parts and equipment flown down on a previous flight.



Record Cargo Airlift—Using an entirely new method and two specially-designed pieces of equipment to load and unload cargo, a USAF C-130 of the 773rd Troop Carrier Squadron airlifted 574,680 pounds of supplies from Tan Son Nhut Air Base to an Army unit at Phuoc Vinh in one day (19 January 1966). The new loading system consisted of a forklift with increased lifting capacity, a 25K loader, and a flatbed truck with steel rollers built into the bed. Here, USAF ground crews run across the Phuoc Vinh landing strip to return cargo tiedown straps to the Hercules, having just dumped a massive load of 55-gallon fuel drums.

Operator responsibility—At the base service station at Cam Ranh Bay, SSgt Harold Crowe, NCOIC of the station, checks the radiator of a Hurricane-4 power plant while the driver, Lt Col Jim Townsend, uses a hydrometer to check the battery.

Vietnam Logistics—Its Meaning for Tomorrow's Air Force

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What experience and history teach us is this—that peoples and governments never have learned anything from history or acted on principles derived from it.

Georg W. F. Hegel, *The Philosophy of History,* 1827[1]

Hegel's view may well be accurate in many instances. But, in the case of the United States Air Force's (USAF) logistical experience in Vietnam, we have been able to glean some accurate and valuable lessons. More importantly, our logistical posture today and plans for the coming decades indicate that the lessons have been *applied*. What we did in Southeast Asia (SEA) was important. We did some things wrong; we did some things right. But none of that is worth much if we did not learn anything and put that knowledge to use in designing better logistical concepts and systems.

SEA Support Concepts

To understand fully the logistical environment in which we operated in Vietnam, we need to recognize that we did not go into SEA in one big surge. The USAF and other services had been building logistically as early as 1960. In 1961, we assigned about 5,000 people to SEA in an "advisory" function. Then the operational situation grew into a "30-day TDY" stage, during which time we did no wing/base supply or maintenance functions in-country. We performed maintenance using mobility kits designed to sustain *two* flying hours a day, *per aircraft*, for 30 days! Later, we stretched the 30-day TDY concept to a "180-day TDY" operation, but still with the same temporary and limited mobility support concept.[2]

The events that ended in the Tonkin Gulf incident escalated the war and led to decisions to build permanent, self-sufficient SEA operating sites. The deployed forces in SEA were supported under the forward operating base (FOB)/main operating base (MOB) concept. FOBs were manned and equipped to provide only the basic necessities required by rotational units. Tactical units from permanent Pacific Air Forces (PACAF) "home" bases were deployed on a rotational basis, and the level of maintenance was done on a "remove and replace" basis.

The MOB, farther removed from combat than the FOB, was equipped and manned to provide more support. The MOB was responsible for the total organizational/field-level maintenance of all wing aircraft deployed to the FOB, including periodic inspections on aircraft and cold section repair on jet engines.

It was not long before our units were flying two to three times their normal flying hour programs under very difficult conditions. The requirements on Air Force Logistics Command (AFLC) for supplies were rapidly increasing.

Supply

Resupply of SEA started with the speed through air resupply (STAR) concept. Requisitioning went from the deployed unit direct to the AFLC system manager and, because of the limited quantities in the kits, resupply was entirely by air. Obviously, STAR could not, and did not, last long.

Then a major, the author flew F-105Ds with the 355th TFW, Takhli Royal Thai AFB. The Thud carried out more tactical strikes against the North than any other aircraft. Operating against ever-stiffening defenses, F-105Ds also led in SEA battle losses.

In 1965, AFLC instituted Project Bitterwine to help support the 19 permanent, self-sufficient bases in SEA. We did it by starting Harvest Eagle which provided largely tent cities; setting up temporary buildings, prefabs, and shelters; and then building more permanent buildings, runways, and support systems.

The problem was that PACAF, or the local SEA base, simply could not determine or requisition what was needed. Consequently, AFLC took the lead and "pushed" what was needed without requiring a requesting action. Stateside depots prepared, assembled, and shipped complete logistics support packages, configured by shop, to provide the supplies and equipment necessary to start up the SEA bases. We also

An air inflatable supply storage shelter at Cam Ranh Bay during the early SEA buildup. These double wall shelters were also used to house maintenance shops.

"Things were changing so fast there was no way to divert supplies no longer needed."

developed standard, simplified manual accounting procedures for use at the forward bases.

One problem was that things were changing so fast there was no way to divert supplies no longer needed. So, a lot of materiel arrived where it was no longer needed and had to be redistributed or returned to active Air Force inventories. Various cleanup projects (like PACAF's Commando Purge and AFLC's Commando Ripe) processed over $34 million worth of materiel.

Another serious problem was that the Air Force did not have any spare support equipment. Generally, at least one squadron of a deployed wing remained in the CONUS and wing/base support equipment became a real problem. With the building of the new bases and the lack of procurement lead time, CONUS bases were surveyed and, in some cases, partially stripped of support equipment.

Port space, storage facilities, and accounting procedures were so limited that many normal accounting procedures and normal actions had to be waived—or the stuff would never go anywhere (all local supply responsibilities for SEA bases were restored in 1968).

In-theater conditions like these forced us in 1965 to send over AFLC rapid area supply support (RASS) and rapid area transportation support (RATS) teams to help clean up the in-theater logistics logjam. Initial cadres of 10 supply specialists at each Air Materiel Area (AMA) evolved to two 60-man cadres (one military and one civilian) plus a 20% reserve at each AMA. During the peak, over 2,500 AFLC employees volunteered to help in SEA.

At each base they visited, the RASS teams helped to reduce the backlogs and restore order in the base supply functional areas. When the teams left, many bases regressed to their original state. So the RASS teams made many trips back to SEA—whenever the workload exceeded the base capability. The need for RASS teams declined in 1969, but the demand for RATS teams increased (packers and craters)—both were a direct drain on AFLC civilian specialists.

Also, operational units needed help from AFLC rapid area maintenance (RAM) teams. Initially, these teams were composed entirely of civilians, but were later integrated with active duty military people from the AMAs. They did a good deal of the crash/battle damage repair in-theater and,

Bitterwine cargo is transferred from a freighter to a landing boat off the coast of Qui Nhon. The project directive told AMAs to provide the "complete range of spares and equipment needed to transpose a bare strip at a jungle base into a full blown main operating base capable of providing full maintenance support to various high performance tactical fighter and troop carrier aircraft."

eventually, more on-site repair work was being performed than anticipated. These procedures proved much more effective and economical than sending the aircraft to CONUS depots for repair.

Having a reserve of maintenance people ready at each AMA allowed AFLC to answer maintenance requests within 18 hours. But the teams felt their way. They lacked experience in determining what maintenance support could be done on-site; how long it would take, based on the damages incurred; and what parts should be ordered to support on-site maintenance. Consequently, some crash/battle damaged aircraft were returned to CONUS because parts could not be secured in time. Some, in fact, were returned to CONUS only to be determined beyond economical repair.

Maintenance

We learned some important lessons about the MOB/FOB concept. Our maintenance and supply capabilities were always behind the power curve. We took much too long to move

"Growing maintenance requirements at the forward bases generated increased needs in-country for facilities and people."

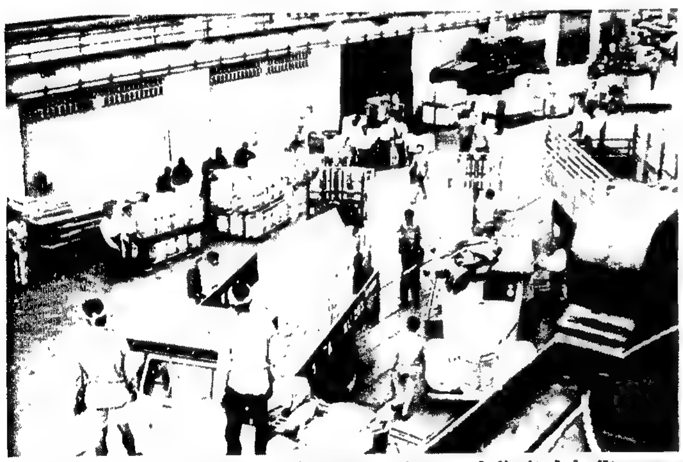
reparables and operational aircraft to and from the MOB for scheduled and depot-level maintenance. In early 1965, commanders began to press for increased capability, self-sufficiency, and improved materiel reaction time. The MOB at Clark, for example, which was responsible for F-4s and F-100s—among others—could not keep up and that had an impact on the FOB's ability to meet its operational requirements. At the same time, growing maintenance requirements at the forward bases generated increased needs in-country for facilities and people.

A "Big Tilly" salvage crane, with 100,000-pound capacity, lifts a crippled F-4C Phantom for transport to a rear maintenance area. Special radar homing and warning gear enabled the two-place fighters to act as Wild Weasel killer pack leaders for air strikes on radar and surface-to-air missile sites.

For a variety of reasons, AFLC could not develop—in a non-mobilized state—a maintenance capability that could meet the total depot maintenance requirements while supporting the high use of available manpower and funds for maintenance support to SEA units. Consequently, the amount of unprogrammed workload accomplished by the AFLC AMAs during this period went from 6.8% of the organic man-hours in FY65 to around 20% in FY70. Most was SEA-related. For example, PACAF asked AFLC to perform vehicle maintenance support—a tasking AFLC was simply not manned to do.

Since depot maintenance manning and facilities remained fairly stable throughout this period, AFLC had to place more and more items on contract, as funds permitted. As a result, by mid-FY70, the AFLC organic facilities and work force were supporting only 45% of the total depot maintenance workload.

Munitions were another problem. Because the Office of the Secretary of Defense and the Air Staff closely controlled funding, item requirements, and distribution, the Air Force was constrained in the amount of munitions it could pre-stock. Add to that the short lead time we had to impose on suppliers, and the problem became epidemic. War plans called for "small" contingency support. Yet, with the SEA buildup, force structure and sorties were escalated to the extent that, without new production, we had to redistribute items from other areas to SEA to cover the interim support.



Due to the many transfer/holding points and limited built-up harbors in Vietnam, the regular Military Sea Transportation Service (MSTS) pipeline became clogged with a 7-8 month supply of badly needed munitions. Project Special Express provided dedicated ships, floating storage, and selective discharge to break the logjam.

Transportation

Problems in transportation were also pretty basic. We had difficulty knowing what was in the pipeline and determining which shipments directed as airlift should actually have gone by surface or ship. Expediting priority shipments proved impossible. In addition, it did not take long for our lack of research and development in packaging, equipment, and materials handling vehicles to show. The unforgiving SEA climate took its toll. We did not have enough qualified transportation people in-country with the materiel, nor enough automated data processing (ADP) to keep track of it properly. Finally, our "push" system was sending much more materiel than we could handle—we did not have enough port, depot, terminal, or base facilities to handle it.

Military Air Command (MAC) established a MAC "channel" from Hill Air Force Base (known as SEA-Air) to move critically needed USAF munitions quickly. But the planes often returned from SEA with battle-damaged aircraft that could not be repaired in-theater. By 1969, back-up stocks in SEA reached the point that most munitions could be transported by more economical means and SEA-Air was discontinued.

Tomorrow

In Europe, the Middle East, and Central America, we face potential combat situations, each quite different from Southeast Asia. But we learned some very important, *translatable* lessons from our experience in Vietnam, Thailand, and Cambodia.

"We proved in Vietnam that battle damage repair could increase our wartime sortie rates."

To begin with, we started a process in the mid-seventies of posturing our depot maintenance capabilities against *wartime*—rather than *peacetime*—requirements. This planning process is ongoing and will assure a significant improved wartime support capability.

The RAM team concept proved its worth in SEA. We must plan to repair battle-damaged systems in the operational theater as much as resources permit—by resources I mean people, equipment, and whatever kind of in-theater contract facilities we can depend on. We have set up two centers—Support Group Europe and Support Center Pacific—to handle some limited maintenance requirements like component repair and corrosion control. We also have significant contractor support overseas—outfits like CASA Getafe in Spain and Kimhae in Korea—support we could depend on in a conflict. These centers provide theater-level maintenance capacity.

In addition, we have capitalized upon the SEA concept of highly mobile, self-sufficient maintenance repair teams. AFLC currently maintains 79 aircraft battle damage repair teams of active duty and reserve maintenance technicians tasked to deploy worldwide to augment the operational forces.

"We must be cautious not to use SEA as an example of air base protection."

These Combat Logistics Support Squadrons (CLSS) stand ready to deploy to any location in the world where aircraft may require battle damage repair.[3] We proved in Vietnam that battle damage repair could increase our wartime sortie rates; it can work again in the Persian Gulf, Europe, or the Pacific.

As in SEA, we still must rely on large intermediate shops to keep aircraft flying. An important goal of current programs is to eliminate this dependency. To achieve the flexibility and mobility needed in wartime, we are moving toward two levels of maintenance for many of our subsystems. Systems can be maintained at FOBs by replacing components or minor repair. To the extent possible, engineers are designing systems that will not need an extensive intermediate level "logistics tail."

If we build our new systems better, they are going to need far less people to fix them. Fixing them when they do break

should be a lot less complicated for maintainers at the FOBs because of the expanded use of line replaceable units (LRUs). To make this concept work best, our systems need fault isolation capabilities to help people "point their fingers" better at the sick box so they can replace it more quickly.

An area in which we must be cautious *not* to use SEA as an example is that of air base protection. Although there were some notable exceptions, our MOBs and FOBs could operate largely under an umbrella of local air superiority. We will most likely not have this luxury in the future, and SEA support concepts would be highly inappropriate to apply.

Our increasingly more complex weapon systems have created fragile weapons platforms that depend too much on "support tails." These structures are tied to immobile and vulnerable basing systems that in turn depend on fixed facilities, electrical power, air conditioning, spare parts stocks, sophisticated and complex support equipment, vulnerable runways, and navigational aids.

We need to reduce the number of support people and equipment in the combat theater—then we can reduce the facilities and information needed to support them. Today, weapon systems and facilities are prime and lucrative combat targets!

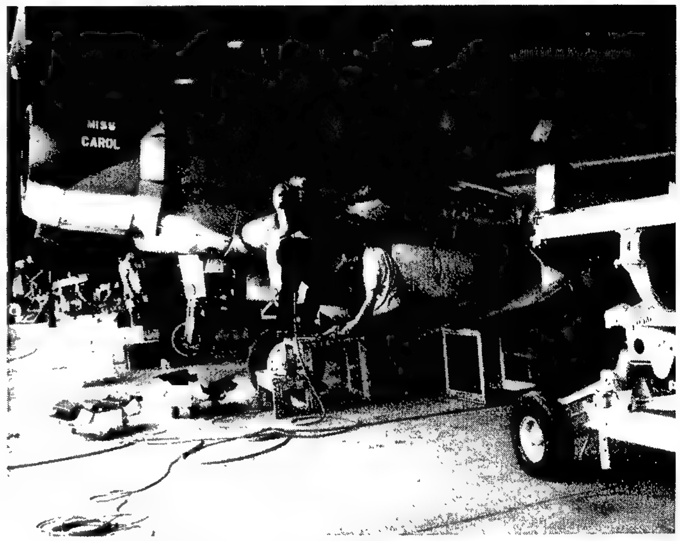
Correcting this problem will not happen overnight. But a key step is the concept of Reliability and Maintainability 2000. Under this concept, we consider a weapon system's reliability and maintainability (R&M) as important as its battlefield performance. The objective is to create forces that can operate in any combat environment and can deploy with minimum combat support.

While system designers tackle the R&M challenge, AFLC is working toward the same goals on several fronts. We are working to shrink Air Force logistics consumption of total Air Force resources, primarily through Weapon System Master Planning with users. We are considering our mission—to acquire, repair, remanufacture, and distribute materiel—as a single process. We are working harder to influence and help shape technologies we inherit from industry and the labs. We are becoming much more literate in technology and developing business strategies to exploit technological advances. Finally, we have identified senior-level people across the system life cycle to work R&M issues—from the Logistics Operations Center for today's systems, to the Air Force Acquisition Logistics Center (AFALC) for new systems.

More modern weapons that break less and quick-fix LRUs will go a long way toward eliminating the SEA logistics horror stories mentioned earlier. We learned a lot about combat supply operations, materials handling, and both strategic and tactical airlift from our involvement in SEA—knowledge that complements the advancements made in reliability and maintainability.

"The specifications for our new vehicles call for a ruggedness not found in the Vietnam era."

We know we have to shorten the pipeline—and we can; we have found smart ways to do that with selective prepositioning of war reserve materiel (WRM) stocks of munitions, vehicles, housekeeping sets, and aircraft support equipment. We have embarked on entirely new ways of containerizing cargo for movement by multiple modes and are continuing to improve how we document and account for cargo using LOGMARS technology—similar to the bar codes at the BX and Commissary.



Sheetmetal specialists from Sacramento Air Materiel Area remove the leading edge from an A-1H wing at Pleiku Air Base, South Vietnam. From 1965-69, AFLC RAM teams repaired 1,077 aircraft, 845 of which were fully repaired on site.

These improvements promise to reduce obstacles, eliminate bottlenecks, and streamline the process of converting requisitions into realities. In distribution areas, many of our materials handling and support vehicles have been converted to diesel; the specifications for our new vehicles call for a ruggedness not found in the Vietnam era, but that is vital if we are to cope with potential austere field operations of the future.

We are beginning to see container lift vehicles in our strategic ports and some in-theater supporting rail movements. Retail supply activities in some MAJCOMs are reorganizing into a Combat-Oriented Supply Organization (COSO) in which supply is closer to the weapon systems supported.

Within distribution, improved supply, storage, stockage, and shipment tracking systems will take our wholesale and retail supply functions out of the old batch, punchcard formats into a real-time mode where shipments are made in a "paperless" environment.

Conclusion

If, despite our dedicated efforts to prevent it, another large scale military challenge confronts us, it will find us with weapon systems that break less frequently, are less vulnerable to combat damage, require fewer support people and equipment, and need only minimum work for their next mission.

Another great philosopher once said: "The future sure ain't what it used to be." In this case, I sure hope Yogi Berra is right!

Notes

[1]Hegel, Georg W. F. *The Philosophy of History*, 1827.

[2]Most of the factual research for this article is from the *Air Force Logistics Command Analysis of Logistics Support to Southeast Asia*, HQ AFLC/XO, December 15, 1970; Part Four of *Corona Harvest Report on USAF Logistics Activities in Support of Operations in Southeast Asia*, Air University, Maxwell AFB AL, August 1970; and *Logistics Support in the Vietnam Era: A Report by the Joint Logistics Review Board*, Vol 1, undated.

[3]CLSSs were indeed organized during SEA, but not used very extensively because of in-theater assignment ceilings and other restrictions.

A General's Reflections: Stress and Combat

On the night marking the start of the Tet Offensive, 29 January 1968, Major Leo Marquez was serving as Acting Chief of Maintenance, 3rd Tactical Fighter Wing, Bien Hoa Air Base, Republic of Vietnam. In the following monologue, he reflects on problems inherent in providing logistical support for an operational wing on a large SEA base with a highly diverse variety of aircraft and missions. With this as background, he recounts the sense of confusion and psychological stress placed on support troops as incoming rockets and rumors of imminent invasion transformed a "sanctuary" base into an embroiled battlefield. His recollections are worthy of attention in the 1980s, as American airpower seeks to deal with the increased range and lethality of weaponry and the rapidly vanishing security of protected rear area bases.*

The maintenance organization used in Southeast Asia was a significant departure from the classic AFM 66-1 structure I had grown used to in the States. Tactical flying squadrons had, in effect, their own maintenance crew chiefs and load crews, who were supported on dispatch by field maintenance, avionics, and gun services shops belonging to the Chief of Maintenance. The Munitions Maintenance Squadron dealt with neither aircraft systems nor loading; they ran the bomb dump and munitions control. This was a very complex operation with tremendous problems in receiving munitions (by both truck and barge), inspecting and accepting them, breaking them down for storage, assembling them, and finally delivering them in time to meet rapidly changing missions.

We had 17 separate flying organizations on the base, all dependent on the 3rd TFW for air base, maintenance, and munitions support (and the 3rd TFW was in turn a tenant of the Vietnamese fighter wing and depot). Unfortunately, taskings didn't come down to any centralized entity, but were diffused to the fighter squadrons, air commando units, forward air control (FAC) units, and gunship outfits. Squadron commanders decided each morning—if we were lucky—the formations they would use to fulfill taskings sent to them from their separate higher headquarters off the base. The Ranch Hand operation responded directly to 7th Air Force and I never even knew their tasking. For Ranch Hand, we tried to plan around a min/max number of sorties sent off in two launchings, but the tremendous variations made useful maintenance planning virtually impossible.

Inability to plan field maintenance resulted in a lot of wasted effort. Some units were way overmanned and others undermanned, but fighter squadrons would not lend people to each other. We in maintenance could not concentrate manpower because we simply did not own it. I saw the maintenance force as neither fish nor fowl—owned by the flying units but crying out for some kind of firm direction and control from somewhere within the maintenance structure. I had learned that the Air Defense Command (ADC) solution—providing centralized direction from a maintenance control office located remote from the flight line—was *not* the way to go. Though contrary to ADC policy, as OMS Commander I had exercised strong authority *from the flight line* where I knew what was needed and could call for the right help at the right time.

I arrived at Bien Hoa having already developed an antipathy toward off-scene decision-making and was willing, as Chief of Maintenance, to grant a tremendous amount of latitude to local line chiefs. They recognized my receptiveness to their problems, and we were able to work together quite effectively despite the fractious organizational setup.

Though we were able to make the maintenance organization work, the basic setup was structurally untenable. Important tasking information flowing down through operations channels (and eventually to crew chiefs and load crews) would be totally different than that coming down through maintenance. That left the flight-line troops squarely in the middle—something good leaders *never* want to do. They need clear lines of communication, command, and control.

These inherent seeds of organizational uncertainty compounded the sense of confusion when the Tet Offensive lit off. The attack came at about 2 a.m. Tet was a Vietnamese holiday but we had not dictated a standing down the next morning. We were going on with the full flying schedule, although there was talk of another truce being arranged for Tet. But when the rockets started coming in and the warning sirens started blaring, it got a bit scary. People were running around trying to find shelter anywhere. We had not had an attack since September—and that had been mortars, not rockets. The 120-mm rocket was an especially frightening weapon because, in addition to doing damage as a fragmentation weapon, it made a lot of noise. They started landing among the airplanes and scattering fragments among the hooches. Great fires were raging and the firefighters were unable to put them out. People were standing around staring and were too frightened to act.

Dawn finally came after a night of considerable heroism on the "ramparts." The Air Police were superb in pinning down a superior force until daylight, and we were able to get some Army helicopters safely off the ground to pin the attackers down. The situation was still not stabilized the next day, though. The troops had not yet cleared the approach end of the runway. There were still a lot of Vietnamese hiding in the weeds, and it took us a long time before we were able to form a skirmish line and move up to ferret them out.

In the midst of all this, we were trying to put out the fires and get people organized. But the word coming down was very diffused. The lack of clear command and control lines took its toll. My boss, the DCM, was giving me no information that day. The DO, if he knew anything, was not getting the word down to us. As best we could tell, the focus seemed to be on the air base commander, who had the job of defending the base with his Air Police. Through it all, there was rampant confusion and no one knew if another attack was imminent. I had determined by 6 a.m. that there were certain things we had to get done—clean up the airplanes, move and shelter them, and perform a variety of cleanup tasks to start people working. It's hard, but important, to keep busy in the aftermath of one of these things. Some were scared; some were totally out of their minds; others were enjoying it!

As dark approached again, the rumor mill buzzed that Viet Cong had been found lurking behind the barracks, others were seen on the other side of the base, and a force of 2,000 was about to attack during the night. Everyone wondered if the Army would be there to protect the base. When darkness came, someone gave orders to issue weapons. Before I knew it, I had 500 armed aircraft mechanics running around with weapons, no enemy to shoot at, and no one in charge. After a while, a gun would go off followed by 17 more guns firing at the sound—they were just firing at noises. It took me four hours to retrieve those guns. I did it on my own authority. Somebody reported that I was taking up weapons, so I had to defend disarming the troops in the face of danger. My reasons were clear—I was afraid my troops would kill each other off before dawn.

The point is that there is a lot of confusion in the aftermath of attack. If people are not mentally prepared to think about it—and we were not—they are going to lose an awful lot of control. Fear drives people to do very irrational things, as everyone worries about the latest rumor, keeps tabs on who has been hurt, and tries to figure out what to do based on very incomplete information. It takes a lot of discipline to get people back together and working productively.

That is what we would have to cope with in the first days of a conflict in Central Europe. We have to deal with the mentality problem and find mechanisms to maintain discipline and keep people informed about what is happening. Let's hope that whatever happens is not a surprise because, if we are caught in

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The C-141B Stretch Program: A Case Study of the Relationship Between the Military and Defense Contractors

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The following case study is divided into two parts: contracting and price negotiations (this issue) and testing and production (Winter issue). The article captures the historical events of the C-141B stretch program and illustrates a more positive side to the government-contractor relationship.

In an era when media headlines are filled with stories about contractor abuses, it is worth remembering that most companies, most often, provide important weapon systems essential to national defense. This study deals with one such relationship which had unique contractual and procedural features designed to assure both fiscal prudence and popular credibility. It is a story which is typical and unusual at the same time—a case study of a weapon system born out of necessity, but conceived by foresight and vision.

"The inability of its primary cargo transport to refuel while in flight nearly cost America her foremost Middle East ally."

In October and November 1973, during the Yom Kippur War between Israel and several Arab states, America's European allies nearly thwarted the US effort to resupply Israel's depleted military stores by refusing to allow American C-141A Starlifters to land at American bases in Western Europe. Luckily, Portugal relented and allowed planes to land at Lajes Field in the Azores to refuel.[1]

American leaders learned a valuable but frightening lesson in spite of the ultimate success of the effort. The inability of its primary cargo transport to refuel while in flight nearly cost America her foremost Middle East ally. American policymakers left it to the Department of Defense (DOD), specifically the Military Airlift Command (MAC), to find a cost-effective solution.[2] The time and expense of producing a new cargo plane, as well as training new crews, made the development of a new series of transports prohibitive. Engineers realized the C-141A's engines could lift cargoes much larger than provided by the plane's original fuselage design. They believed the best solution would be to lengthen its fuselage to the limits of the cargo capacity and add an aerial refueling capability. This 30% increase in cargo capability was relatively inexpensive and would add an equivalent volume of 90 additional aircraft. Such a modification could be achieved quickly, and the new plane could be flown by the same crews.[3]

In response, the Lockheed-Georgia Company, late in 1973, sent the Air Force a proposal which called for adding a 160-inch fuselage section forward of the wing and a 120-inch section aft of the wing; strengthening the center fuselage with titanium straps to compensate for the higher bending loads; installing new, Lockheed-designed wing fillets to further streamline the aircraft; and removing the vortex generators and stall strips to reduce drag.[4,5]

Increasing the plane's volumetric size appealed to MAC's cargo transport strategists, who additionally recommended the incorporation of a standard air-to-air refueling capability to increase the transport's range and allow it to carry more cargo by taking off with less fuel. This would eliminate US dependence on politically unreliable refueling stops that plagued C-141 operations during the Arab-Israeli War.[6]

"Air Force leaders realized the need for a new aircraft and soon agreed with the Secretary of Defense not to delay."

In 1973, the Secretary of Defense earmarked about $80,000,000 for the construction of a single pre-production prototype. After initial problems, Congress appropriated $41.5 million for the single prototype aircraft. This proved sufficient since the prototype was manufactured for only $37.5 million.[7]

In December 1973, the President of Lockheed-Georgia sent a letter to the USAF Assistant Vice Chief of Staff summarizing the cost breakdown and production time to complete the elongation of the Starlifter. Among other things it suggested: "Lockheed can accomplish the C-141 stretch . . . on 275 C-141s at a firm price of $404,943,000. . . . The above price is in escalated dollars and assumes a go-ahead of 1 April 1974. A fixed price incentive type contract is envisioned."[8] Despite initial misgivings, Air Force leaders realized the need for a new aircraft and soon agreed with the Secretary of Defense not to delay.[9]

By the following January, the Air Force issued a Program Management Directive (PMD), "Increased Strategic Airlift Capability, C-141 Aircraft," outlining the various command responsibilities regarding the stretch modification of 276 C-141A aircraft. The number of aircraft to be modified varied slightly since four of the original 280 C-141As, already extensively modified for testing by the Air Force Systems Command (AFSC), were excluded from the original agreement. The single prototype, excluded from the main contract, was to be modified later. However, over the life of the project, C-141 mishap attrition reduced the number of aircraft available for modification to 270. The Air Force Logistics Command (AFLC) was assigned "overall management and integration of the modification program."[10]

The task of developing a modification proposal and analysis (MPA) to outline the general modification procedures fell to the Warner Robins Air Logistics Center (WR-ALC) C-141 program manager.

This MPA, distributed on 23 January 1974, did not mention the single prototype trial program Congress insisted upon, so

C-141 Starlifter flying supplies into Israel after stopping for fuel at Lajes Field, Azores. Near failure of this resupply effort dramatized the need for aerial refueling of US strategic transports.

the USAF Chief of Staff ordered the original MPA reworked to include a prototype.[11] The updated MPA received approval ten months later and led to the issue of another PMD. Subsequently, the Assistant Secretary of Defense for Installations and Logistics approved the creation of a prototype aircraft based on the Stretch Modification Plan, but directed that the program be placed under Defense Systems Acquisition Review Council (DSARC) procedures as prescribed by DOD regulations.

The USAF and Lockheed-Georgia concluded contract FO9603-75-C-0810 in October 1975 for a single stretch prototype to include engineering, tooling, and materiel specifications, as well as verification of modification possibilities through flight testing.[12,13,14]

Steps toward developing a viable production contract proved more complex. In January 1976, the Secretary of Defense directed the Air Force to develop a plan for competitive procurement.[15] The decision to compete or go sole source had become a critical issue due to past cost overruns on other Lockheed projects such as the C-5A "Galaxy." In the late 1960s Lockheed had exceeded its original cost projection of $2 billion by $3 billion.[16]

In early 1977, the Lockheed-Georgia Company soon became the favored contractor because it had been the original contractor for the C-141A and was already under contract to construct the prototype. Moreover, it was the first private group to submit a proposal outlining a plan to stretch the C-141A. Even so, this did not mean the company would automatically receive a contract to execute the actual production. Competition among potential contractors, besides being required by law when feasible, usually reduces costs. In this case, the job of selecting a contractor for a modification of this scope put the Air Force in a position to select from a plethora of reputable companies. Many were invited to submit proposals; however, Lockheed, given the history of the C-141, had the advantage of engineering experience since it had designed and built the Starlifter.[17] This factor, in itself, weighed heavily in Lockheed's favor since it had access to a vast pool of engineers with extensive experience.[18]

Lockheed's knowledge of master gauges and fatigue tests also provided an accrued advantage. Master gauges are large, rigid, sensitive measurement devices designed to ensure production accuracy and constancy of regular production gauges, and guarantee integrity and interchangeability of component assemblies. Parts made in this fashion need little further inspection. Initial creation of these instruments is very expensive and time consuming. Since Lockheed already had these gauges in its production equipment inventory and had experience using them, it could assure reduced expense, shorter production time, and greater production precision.

Lockheed had also previously conducted fatigue life tests and, while some published results enabled other contractors to use the data, most of the test results remained classified and experimental. In addition, most of the tests continued during negotiations, which constantly altered the resulting data and inspection techniques. The process, therefore, lacked refinement and made it prohibitive for another company to assess the actual fatigue impact on the C-141A's design. While another contractor could have developed a data interpretation program, it would have been too time consuming to meet the Air Force's desired deadlines. After all, one of the main reasons for selecting the modification procedure was its shorter production schedule.[19]

The Assistant Secretary of Defense for Installations and Logistics authorized the Air Force to begin sole source negotiations with Lockheed-Georgia in March 1977, prior to an Air Force Systems Acquisition Review Council/Defense Systems Acquisition Review Council production decision.[20] The Air Force notified the Senate and House Armed Services Committee, and the Senate Appropriations Committee, that informal sole source negotiations for the C-141B stretch modification had started.[21] An Advanced Procurement Plan and Justification for Authority to go sole source, and a Determination and Findings document, were sent to Air Force Headquarters in April for the purpose of stretching the C-141A fleet.[22] The Undersecretary of Defense signed the Determination and Findings document the following month which allowed the USAF to negotiate only with Lockheed.[23]

During the summer of 1977, WR-ALC sent Lockheed a Request for Proposal and soon received a lengthy reply indicating that both sides had prepared in advance and wanted to make sure the program moved ahead without delay.[24] After months of thorough research, WR-ALC chose to award the modification contract directly to Lockheed without competition. This decision came from a hard-nosed economic look at what the Air Force could get for its money, plus the urgency of need, the desired quality of the finished product, and support capability for the aircraft's mission.[25]

"The bitter memory of the C-5 overrun publicity spurred WR-ALC management to create the largest Cost Study Team in history."

After mailing the Request for Proposal to Lockheed, WR-ALC began organizing a group to research Lockheed's forthcoming cost proposals. The bitter memory of the C-5 overrun publicity spurred WR-ALC management to create the largest Cost Study Team in history. It had 15 members employed at WR-ALC and 12 from the Defense Contract Audit Agency and Air Force Plant Representative Office stationed at Lockheed.[26] The Team scrutinized every part of Lockheed's cost proposal and interviewed all Lockheed employees responsible for making the estimates. The entire team met in July at Lockheed's enormous Plant Six in Marietta, Georgia, and spent over a month completing the pricing research.[27] Their preliminary report was incorporated into a C-141 Stretch Modification Decision Coordinating Paper written by the WR-ALC Acting Director of Materiel

Management. This report was reviewed by the AFLC Deputy Chief of Staff for Logistics Operations and HQ USAF who in turn submitted it, along with their supporting comments, to the DSARC. These components were eventually incorporated into a Fixed Price Incentive Firm Target Contract which was signed in June 1978.[28]

However, the process had not been completely smooth. Lockheed's original proposal called for new wing fillets designed to give each of the aircraft a wing life expectancy of 45,000 hours. However, during prototype testing, the technical data gathered indicated to the Cost Study Team that the proposed wing fillet failed to be cost effective and should be deleted. Price negotiations, scheduled for the fall of 1977, had to be delayed because of this issue. WR-ALC officials insisted that Lockheed reevaluate its data. In the meantime, the Air Force canceled the Request for Proposal and issued a new one in November 1977 without the wing fillets. The contractor was asked to respond by December 1977. This action eventually caused Lockheed to review and later revise its cost estimate, submitting a new proposal, without the fillet, in January 1978.[29] After a further series of negotiations, production contract FO9603-78-C-1473 was awarded in June. It included standard clauses for a Fixed Price Incentive Contract such as provisions for the contractor to handle engineering design, testing, manufacturing of detail parts, and performance of all aircraft maintenance necessary for receipt and delivery.[30]

"Special contractual provisions were tailored exclusively to the stretch modification."

Special contractual provisions were tailored exclusively to the stretch modification. These included the *Value Engineering/Design-to-Cost Program* which provided for a maximum of $595,510 for engineering in order to ensure that the contractor would be cost conscious during the early critical design stages of the project. DSARC insisted on this feature in order to facilitate cost monitoring.[31]

The *Rights in Data* provision allowed the government to acquire Lockheed's proprietary data from the stretch modification. In addition to data rights secured under this data provision, the government received the right to use Lockheed data in its possession as well as any future information for maintenance, operation, and support of the C-141 fleet.[32] Lockheed was allowed to retain data rights pertaining to parts, components, maintenance, or services related to aircraft or equipment other than the C-141. A *Pre-Contract Costs* section was also included to allow Lockheed to make preliminary preparations to stretch the mainline of C-141s before actually having a contract. To maintain progress on its preliminary preparation, Lockheed requested, and received, $2.8 million for precontract costs. This provision allowed Lockheed to recover costs incurred after 21 March 1978, before signing a contract. However, the government was not obligated if a contract was not signed. While this clause appeared to be an Air Force concession, it actually favored them by forcing Lockheed to continue work between the end of the prototype phase and start of the production phase.[33]

A fourth provision provided for *Annual Options*. Both sides agreed production could be stopped with any year's purchase order or carried through to completion.[34] Variations in yearly and total quantities were also established to eliminate the possible need to renegotiate production targets. This meant that negotiated target costs, price curves, and established unit factors would be used with specific formulas to determine the price of an ordered quantity between a minimum and maximum range.[35]

Some of the most unique contract aspects were the *special monetary incentives*. In nearly all large government production contracts, both parties anticipate that the contractor can manage and produce within the contract's funding estimates. While information from the Should Cost Study Team helped pare Lockheed's projected expenditures during the negotiation phases, the Stretch Modification Contract provided features which made it profitable for the contractor to reduce costs. By using a Fixed Price Incentive Target Contract, the Air Force gave Lockheed a chance to make money by saving money. Lockheed's incentive to hold costs in line came from a sharing arrangement feature in the contract.[36]

"By using a Fixed Price Incentive Target Contract, the Air Force gave Lockheed a chance to make money by saving money."

Both parties originally estimated the work could be completed for $367.5 million. With Lockheed's acceptance of a 10.9% profit, or $40 million, the Target Price was set at $407.5 million. The agreement likewise had a 1978 ceiling price of $459.375 million. Any expenditures exceeding that sum would have to be absorbed by the contractor. The sharing arrangement additionally provided that 25% of any money over $367.5 million would be deducted from the Target Profit of $40 million. For example, if Lockheed's costs came to $400 million, this would be $32.5 million over the Target Cost of $367.5 million. Thus, 25% of $32.5 million ($8.125 million) would be deducted from Lockheed's Target Profit of $40 million which would leave the contractor with a profit of $31.875 million. If the contractor came in under the Target Cost, 25% of the difference would be added to the Target Profit.[37] This portion of the contract induced Lockheed to work at a constant pace to maximize its profit. Continuous production resulted in substantial savings. To take advantage of these savings, WR-ALC negotiated the modification's price based on the volume of the non-stop production level. While funding for the initial phase of the program had been based on need, financing for the main modification became part of a yearly review system. Cognizant that the project might end due to congressional termination of funds, production and expenditure projections were made at specified intervals. Thus, DOD and Lockheed officials knew, from the outset, the tenants that would be used to guarantee an equitable settlement if the program was terminated. Moreover, the government received a continuous production discount on the modification and the right to vary contract quantities without renegotiating prices.[38]

Another clause was added to deal with inflation. To modify the entire fleet would take about five years. This meant inflationary price increases in labor and materiel. To avoid this problem, an *Economic Adjustment* provision was included using a Cost Index which included an identified expenditure profile for the escalation of labor and materiel related costs. Yearly percentage increases were included in the established targets and review of these indexes allowed for yearly adjustments. In the end, this meant that the final ceiling price

set in 1982 came to $511 million, up over $51 million from the original $460 million ceiling price set in 1978.[39]

The stretch modification contracts, although complex, enabled both sides to understand each other and permitted a tranquil production period.[40] While negotiations were underway, the contractual benefits were already being realized from the prototype testing program.

(C-141B test and production will be addressed in Part II, Winter 1987 issue, *AFJL*.)

Notes

[1]Kissinger, Henry. *The White House Years* (Boston, 1979), pp. 645, 673, 955, 962, 1264; Henry Kissinger, *Years of Upheaval* (Boston, 1982), pp. 152-153, 700; Moshe Dayan, *Story of My Life* (New York, 1976), p. 461; *U.S. News and World Report*, 22 Oct 73.

[2]SO ROC No. 2-74 by MAC, "Military Air Command, Required Operational Capability, Enhanced Airlift Capability of the C-141B," 3 May 74.

[3]Ibid.

[4]Interview, Benjamin H. Vincent, WR-ALC Historian, with Col (now Lt Gen) Donald P. Litke, WR-ALC/MM, 2 Feb 79, pp. 1-3 (hereinafter cited as Litke Interview).

[5]Proposal by Lockheed-Georgia Company, NMR 73-9, "Lockheed-Georgia Company to USAF," Nov 73. It should be noted that the added plug was determined by the citing of the best Fuselage Section. The Fuselage Section is the number of inches from the first structural part on the aircraft's nose to its tail, excluding external devices.

[6]Report by WR-ALC/LOG-MMA (M), "C-141 System Program Management," 30 Jun 80; SO MAC ROC 2 (U) by MAC, "Increased Strategic Airlift Capability," 3 May 74; Message (U), HQ AFLC/CC to WR-ALC/CC, "Delivery of YC-141B Aircraft," 1321402 Jan 77.

[7]Project Report by Col Gordon P. Masterson, WR-ALC/MMH, "Personal C-141B Notebook," Jan 78 (hereinafter cited as Masterson Notebook); Report (U) by WR-ALC/MMH, "Narration of the Contract Action, C-141B Stretch Production Program Management Plan," Atch 3, "Contract No. FO9603-78-C-1473," Jan 78 (hereinafter cited as Narration); Conference Action, "Procurement Items," *Congressional Quarterly Almanac*, 93rd Congress, 2nd Session, XXX (1974), pp. 571, 592 (hereinafter cited as Congressional Quarterly).

[8]Letter, Lawrence O. Kitchen, President of Lockheed-Georgia Company, Inc., to Lt Gen Durwood L. Crow, AF/DCS, "C-141 Stretch Modification-Summary," 10 Dec 73. For details of the Air Staff's opposition to the Stretch Modification Program see Litke Interview, pp. 3-8.

[9]Letter, Gen John J. Catton, AFLC/CC, to Gen George S. Brown, CSAF, "C-141 Stretch," 28 Dec 73; Letter, Maj Gen Robert E. Hails, WR-ALC/CC, to Gen John J. Catton, AFLC/CC (C-141 modification), 21 Dec 73; Talking Paper by Major Milnes, USAF/MMEA, "Lockheed C-141 Stretch Proposal," 2 Jan 74, Letters, Gen John J. Catton, AFLC/CC, to Gen Paul K. Carlton, MAC/CC, and Gen Samuel C. Phillips, AFSC/CC (C-141 modification), 2 Jan 74.

[10]SO R-Q 4-043-(1), HQ USAF Program Management Directive (PMD), 16 Jan 74, Report by WRAMA/MMH, "Class V Modification Proposal and Analysis (MPA), Increased Strategic Airlift Capability of the C-141 Aircraft," 26 Feb 74; Report by WR-ALC/MMSH, "C-141 Stretch Modification Production Program Management Plan Contract No. PMD R-0-5050-1," Oct 78, p. 6 (hereinafter cited as PMP 1978).

[11]PMP 1978, pp. 6-7; Report by WR-ALC/MM, "Class V Modification MPA, Advanced Procurement Plan, Air Refueling and Drag Reduction Modification," 8 Nov 74.

[12]AFTEC History Office, *Annual History*, CY77, p. 110.

[13]Message, CSAF/LG to AFLC/CV, "C-141 Stretch Modification Program," 251437Z Feb 75.

[14]Report by WR-ALC/MMSH, "C-141 Stretch Modification Production Program Management Plan, Contract No. FO9603-75-0810," Mar 79, p. 1 (hereinafter cited as PMP 1979), p. 7; Briefing, Col Litke, to DSARC, Review of the C-141 Stretch Program, AFLC/MM, "Class V Modification Proposals for Configuration Changes to the C-141," 9 Oct 75.

[15]Memo for the Record, by Col Litke, "Competitive Enhancement Meetings, C-141 Stretch Program," 7 Nov 75.

[16]Rice, Berkeley. *The C-5A Scandal* (Boston, 1971), pp. 33-45, 113-116, 162-163.

[17]Hearn Interview, pp. 14-16; Masterson Notebook; *Congressional Quarterly*, pp. 331, 338.

[18]Letter, John Martin, Acting USOD to HQ AFLC, "Department of the Air Force Determination and Findings Authority to Negotiate an Individual Contract," 19 May 77; Letter, G. J. Vom Baur, Deputy Director, Contract Placement Office of DCS/Procurement and Production to WR-ALC/MM, MMH, "Procurement Evaluation Panel Review of the C-141 Stretch Modification Request for Proposal (RFP)," 7 Apr 77.

[19]Boeing Company, Seattle, Washington; E-Systems, Greenville, Texas; General Dynamics, St. Louis, Missouri; and Ling-Temco-Vought, Dallas, Texas, expressed an interest, but with varying special conditions.

[20]Report by WR-ALC/PPW, "C-141 Stretch Program Production Planning Review," Jan 76. For examples of the various companies which did not participate in the final contract see: Letters, K. M. Smith, Pres., Air Craft Systems, E-Systems Inc., to Maj Gen William R. Hayes, WR-ALC/CC, 16 Mar 77; Hayes to Smith, 21 Mar 77; Hayes to Gen F. M. Rogers, AFLC/CC, 25 Apr 77; H. B. Gunther, Vice Pres., Aircraft Division Northrop Corporation to Hayes, 29 Jan 76.

[21]Advance Procurement Plan Report, by WR-ALC/MMH, "Increased Strategic Airlift Capability, C-141 Aircraft," 8 Nov 74; Advance Procurement Plan Report by WR-ALC/MMH, "Increased Strategic Airlift Capability C-141A Stretch, Air Refueling and Drag Reduction Modification," 26 Feb 74.

[22]Memo, Dale R. Babione, Acting ASOD/LG, "C-141A Stretch Modification," 4 Mar 77 (hereinafter Babione memo); PMP 1979, p. 9.

[23]PMP 1979, p. 10; *Congressional Quarterly*, pp. 217, 264, 269, 331, 338.

[24]PMP 1979, p. 10; Letter, HQ AFLC to HQ USAF, "Determinations and Findings, C-141B Stretch Program, Class V Modification," 12 Apr 77; Interview, Benjamin H. Vincent, WR-ALC Historian with Henry Hearn, WR-ALC/PP, "C-141B Stretch Modification," 20 May 81, pp. 21-22. Henry Hearn was the contracting officer for C-141B Stretch Modification Program (hereinafter cited as Hearn Interview).

[25]Letter, HQ USAF to Rep George H. Mahon, Chairman, Committee on Appropriations, House of Representatives, 10 Mar 77; PMP 1979, pp. 9-11; Babione Memo; Hearn Interview, pp. 16, 18.

[26]AFPRO personnel work for the Air Force Systems Command.

[27]Office of History, AFLC, *Annual History*, FY77, p. 222.

[28]Briefing, Col Litke to AFLC/LO, "Decision Coordinating Paper (DCP), C-141 Stretch Modification Program," 8 Aug 77; Narration.

[29]Message, WR-ALC/MM to AFLC/LO, "Increased Strategic Airlift Capability, C-141B Stretch Modification Configuration Revalidation (Wing Fairing)," 271730Z Sep 77; Message, WR-ALC/MM to USAF/LGY, 201255Z Sep 77; Briefing, Col Masterson and Arthur G. Atkins, Chief, Warner Robins Detachment to Command Detachment 4, "C-141B Modification (Wing Fairing)," Fall 77 (hereinafter cited as Masterson and Atkins Briefing); Interview Benjamin H. Vincent, WR-ALC Historian with Arthur G. Atkins, WR-ALC/MMST, 12 Sep 80, pp. 24-26, 30-33 (hereinafter cited as Atkins Interview); Interview, Benjamin H. Vincent, WR-ALC Historian with Col Alan L. Trott, WR-ALC/MMSH, by Lockheed-Georgia Company, "C-141B Stretch Modification Configuration Revalidation," 30 Sep 77; Message, WR-ALC/MM to USAF/LGY, "Increased Strategic Airlift Capability, C-141B," 201255Z Sep 77 (hereinafter cited as Airlift Capability); Narration; PMP 1979, p. 8; Message, WR-ALC/MM, MMSH(2) to USAF/LGY, "Increased Strategic Capability, C-141B," 212030Z Oct 77; Masterson Notebook.

[30]Narration; Message, AFLC/LO to WR-ALC/MM, "C-141 Stretch Production Contract," 3 Apr 78; PMP 1979, pp. 11-12.

[31]Contract Administration Services Memorandum of Agreement (Initial) by AFCMD, Det 21, AFPRO, Lockheed-Georgia Company and WR-ALC/MMSH, "C-141 Stretch Production Program, Contract No. FO9603-78-C-1473," 1 Dec 78 (hereinafter cited as FO9603-78-C-1473).

[32]Narration.

[33]FO9603-78-C-1473.

[34]Narration; FO9603-78-C-1473.

[35]Narration.

[36]Ibid.

[37]Narration; FO9603-78-C-1473.

[38]Ibid

[39]Ibid.

[40]Contract Modification on Contract FO9603-75-C-0810 (P00001-P00056), 1978-1982.

FROM 22

Europe with dependents or other noncombatants on board, they will become a terrible distraction.

I learned a great deal about the impact of concern for dependents in 1964 when I had a group of about 80 support troops with me on deployment to Elmendorf AFB, Alaska. On 27 March 1964, Alaska fell victim to the largest earthquake ever to hit North America—8.6 on the Richter scale. All 80 of my men were in two barracks, so I was able to marshal them in 10 minutes to the hangars in which we had parked our F-106s. The damage to the aircraft was incredible. When the hangars began shaking, the big 80-pound overhead lights came crashing down on the wings and fuel starting gushing out of the wet wings. Electric wires were sparking as 3,000 gallons of JP-4 spread out across the floor. Commercial power was quickly lost, and we began turning off everything electrical to prevent sparks when the power came back on. Then we spent about five hours mopping up the fuel and plugging the aircraft, through all of which aftershocks of 3-4 on the scale continued to occur every 20 seconds or so. We whipped the lighting problem by plugging some good fluorescent lights with extensions into the 110-volt receptacles of our NF-2 Light-Alls. Before losing communications, we managed to get one call through to the States that all our people were okay.

With our aircraft temporarily secured, I walked next door to see how the host wing was doing. I picked my way upstairs in the dark to the Chief of Maintenance's office. He was sitting in the dark with four NCOs and no communications. They hadn't even considered the power available from the 30 Light-Alls right outside the window. In essence, no one was thinking. The wing had been unable to raise any more of its people—who were naturally more concerned about what had happened to their homes and families. Their attention was hardly on fixing airplanes. And, though things were far from calm, no one was shooting at them or lobbing bombs in, as would be true in wartime.

If forced to fight before evacuating our noncombatants, we would truly have a tough problem. We'd have to be able to assure our people that *everything possible* was being done to protect their families. Otherwise, the tremendous combined stress of launching aircraft, sustaining damage and injury, and worrying for the safety of families could prove overwhelming.

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Blue Two Visit Program

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The Air Force has been quite successful in fielding weapon systems that *perform* as designed. But, too often the real costs—in terms of production, spares, and man-hours—of achieving that performance have been great indeed. To address this problem, the Air Force Reliability and Maintainability Program, known as R&M 2000, was developed by direction of the Secretary of the Air Force and Chief of Staff of the Air Force. The intent of R&M 2000 is to institutionalize the Air Force's commitment to improving reliability and maintainability of fielded and future weapon systems.

A relatively new effort which affirms the Air Force's R&M commitment is the Blue Two Visit (BTV) program, managed by the Air Force Coordinating Office for Logistics Research (AFCOLR). This program exposes corporate program managers, design engineers, and appropriate Air Force system acquisition personnel to "real world" operating and maintenance procedures and constraints. By allowing direct communication between the designers and day-to-day maintainers of current Air Force systems, design engineers are encouraged to incorporate reliability, maintainability, and supportability features into the planning of future weapon systems. The program also helps Air Force acquisition participants to "get smart" about "real world" problems existing in the operating environment.

CMSgt Danny Lewis, Lt Col Norman Fleig, and Col John C. Reynolds (AFCOLR); the Joint Advanced Fighter Engine Program Office; and Lt General Leo Marquez, Deputy Chief of Staff, Logistics and Engineering, HQ USAF, started the BTV program in December 1983. The first BTV trip, 4-16 December 1983, focused on the Joint Advanced Fighter Engine (JAFE) program. The participants were General Electric, Pratt and Whitney, Air Force Wright Aeronautical Laboratories (AFWAL), Aeronautical Systems Division (ASD), Air Force Acquisition Logistics Center (AFALC), AFCOLR, and the US Navy. The group visited units at Langley Air Force Base, Virginia; Norfolk Naval Air Station, Virginia; Oceana Naval Air Station, Virginia; Kelly Air Force Base, Texas; and Eglin Air Force Base, Florida. The exposure of designers to the types of maintenance problems impacting readiness and man-hour rates was a true "eye-opener." The trip gave designers the opportunity to play the role of maintenance technicians. They discovered the limitations of the operating environment—limitations that did not seem so significant on the design board years before. The favorable post-trip comments and lessons learned exceeded all expectations.

To date, there have been 18 trips with 235 contractors and 150 DOD/USAF personnel participating in the BTVs. The Joint Advanced Fighter Engine (JAFE) trip started the ball rolling. Since then, AFCOLR has arranged, at the request of four different system program offices, six specific BTVs, three of which were JAFE BTVs. The three remaining centered around a very high speed integrated circuit (VHSIC) BTV, integrated electronic warfare system (INEWS) BTV, and integrated communications, navigation, identification avionics (ICNIA) BTV. The other BTV trips have been generic in nature covering avionics, flight controls, engine monitoring systems, training, communication/radar, and ordnance. The remaining 1986 schedule will center around tactical communication and aircraft composites. The program is steadily gaining recognition and support. More and more contractors and military planners want to be included in future trips.

A BTV lasts five days. During that period, personnel visit at least four major commands at four different locations. The day starts at dawn and the team spends a minimum of 10 hours on base and travels at night to the next location to start over again the next day. Participants are encouraged to talk to maintainers and enter into their world of extreme cold and hot weather, rain, wind, snow, chemical, biological, and radiological (CBR) gear—this is the *real* world! The BTV program is smart business, not just for contractors but also for the Air Force. It is an opportunity for commercial companies to see the Air Force in the real environment and see how and where their systems will operate. More importantly, they can talk to people who make equipment work or have to fix it when it does not work.

Maintainers, regardless of location or weapon system, continually discuss the same problem areas and have recommended:

- **Elimination of safety wire:** Safety wire has been around a long time, and even though technology has brought us to the point where it can be eliminated in many areas, designers/developers still use it. In some instances, the Air Force still requires it. Elimination of safety wire, where it is not needed, can save an enormous amount of man-hours, reduce foreign object damage, protect against damage to chemical protection gear, and eliminate two hand tools (safety wire pliers and dikes).

- **Reduction of bolts in all areas:** The number of bolts in items such as access panels, flanges, and component mounting has become a severe problem. For example, not only have dozens of screws been installed in access panels, but they usually require more than one type of hand tool. Flanges on components pose just as many problems as access panels. The flanges have different size bolts and different lengths, require numerous tools, and always have to be torqued. Also, the way components are mounted to main components is a fertile field for improvement. Components may have only four bolts attaching them, but the mechanic usually has to remove several other components to get to the failed part.

- **More reliable fault isolation:** Once an item fails, it often becomes difficult to find the fault in a timely manner. Too often, failures cannot be duplicated, components retest serviceable, or mechanics become bogged down chasing solutions through a long string of technical manuals. If fault isolation is to be built into the component, the failure flag should be black. Maximum fault isolation capability should be built into components to help reduce the amount of test equipment, technical manuals, and support equipment the Air Force must deploy.

- **More efficient removal and replacement of electronic boxes on the airframe:** Airframes have become a mass of black boxes. This is an ever-increasing problem with which maintainers must live. Consider a few suggestions which may help in the removal and replacement of such boxes:

  (1) Do not place a box with a low mean time between failure (MTBF) in a location where removal requires disassembly of several other components.

  (2) Remove safety wire from the cannon plugs.

  (3) Place cannon plugs in an accessible location.

- **Better foreign object damage (FOD) resistant engines:** Because aircraft operate in virtually all environments, FOD will occur. Engines should be designed to be more tolerable to such damage. Also, the repair capabilities of the field mechanic must be considered in the acquisition of new technology engines.

- **Improved technical data:** Technical data has been a long-standing problem. Unfortunately, it seems to be getting worse. The major difficulties are:

  (1) No commonality exists between weapon systems on how a technical order (TO) is designed. For example, compare the General Electric TF-39 engine work package format to the Pratt and Whitney F-100 format. There really is no comparison except they are both

TOs.

(2) Mechanics may spend 30% of their time looking up information.

(3) Field level TOs have more information in them than the mechanic is allowed to perform.

(4) Equipment arrives in the field prior to the TO change.

(5) On occasion, the Air Force purchases equipment without technical data because the manufacturer is responsible for its repair. But, if the contractor decides not to repair it anymore, the mechanic must repair the equipment without technical data.

Personnel who have participated in BTVs are listening to the maintainers. They have started to incorporate a lot of their findings into independent research and development (IR&D) programs and also into the systems they support in the field. Some specific findings are shown in the box on this page.

Blue Two Visits are very important to the Air Force and contractors because everyone has the opportunity to talk about problems. There have been significant gains in some weapon system programs due to participation in the BTV program. Credit for the success of the program must go to the young airmen who maintain, and will maintain, our country's weapon systems. Their ideas are invaluable and should be considered so the Air Force can take full advantage of the R&D process.

Findings

(1) Ground Support Equipment (GSE):

- **Design better transfer stands.**
  - **(1) Make more mobile.**
  - **(2) Make lighter for ease of handling.**
- **Manual and hydraulic backup for electronically powered GSE.**
  - **(1) Require different voltage and cycle availability overseas.**
  - **(2) Require additional support equipment to produce the needed power.**
- **Eliminate special tools, especially at organizational level.**
- **Make maximum use of common tools, keep number to minimum, and use in multiple application.**
- **Provide more durable test equipment (rugged, not susceptible to moisture, humidity, etc.)**
- **Use lightweight fixtures.**
- **Provide turbine flow measurement capability at intermediate level.**
- **Provide ability to test modules (core) prior to assembly at intermediate level or prior to dispatch from depot.**

(2) Basic Engine Design:

- **Provide capability for easy engine removal/replacement from aircraft.**
- **Use modular design.**
- **Minimize number of connecting bolts on flanges between modules.**
- **Eliminate requirement for engine trim (incorporate self-trim capability).**
- **Minimize number of test leads needed for test cell installation (reduce time to hook up/disconnect engine from test cell).**
- **Use quick disconnects on electrical connectors.**
- **Have break points in electrical harnesses to ease removal/replacement.**
- **Have alternate methods of starting engine.**
- **Incorporate engine monitoring system (EMS) with recording capability to fault isolate.**
- **Maximize local repair capability (no proprietary repair process).**
- **Minimize number of fabrication welds (source of fatigue cracks).**
- **Minimize total number of parts in engine design (improved R&M).**
- **Eliminate fir tree design for disk/blade slots.**
- **Eliminate safety wire (external and internal), especially where organizational level maintenance is involved.**
- **Mount accessories on airframe vs. engine (no quick engine change (QEC) kit for engine installation).**
- **Maintain single depth accessibility to components, plumbing, etc.**
- **Have the ability to change components easily when the engine is in the aircraft, even if maintenance personnel are dressed in CBR gear.**
- **Eliminate blind installations.**
- **Eliminate use of RTV sealer.**
- **Provide capability to borescope engine (fan, compressor, and turbines) while installed in aircraft.**
- **Have the ability to remove/replace high maintenance items (fuel nozzles, igniter plugs, thermocouple probes, etc.) while an engine is in the aircraft or without having to disassemble the engine.**
- **Have the ability to conduct compressor wash and corrosion treatment while the engine is in the aircraft.**
- **Provide accessible oil tank quantity indicators.**
- **Eliminate use of fuel-cooled components where spillage during removal/ replacement is possible (problem when using CBR gear, fire hazard).**

(3) Airframe Design:

- **Provide accessibility to perform all required engine maintenance.**
- **Provide capability to rapidly remove/replace an engine with a minimum of interconnects.**
- **Provide high-torque fasteners that can withstand the rigors of power-driven removal without tearing heads and that do not vibrate loose and FOD the engine.**
- **Limit number of fasteners on an access panel.**
- **Limit number of items to be removed to accommodate removal of failed items.**

(4) Avionics Design:

- **Reduce number of connectors.**
- **Eliminate safety wiring connectors.**
- **Eliminate blind mating connectors.**
- **Reduce test equipment.**
- **Build in more fault isolation in line replaceable units (LRU).**
- **Reduce fuel-cooled LRUs.**
- **Simplify technical data.**

Most Significant Article Award

The Editorial Advisory Board has selected "In Search of a Better Eagle's Nest" by Major General George E. Ellis, USAF, as the most significant article in the Summer issue of the *Air Force Journal of Logistics*.

Essay: Pyramids and Stovepipes

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Two terms are currently in vogue when Air Force logisticians talk about career progression—pyramids and stovepipes. Both terms bring to mind structures which, when associated with military careers, say something about chances for advancement. They also infer command and management structures, as well as breadth and depth of experience in logistics specialties.

This essay describes the difference between the two structures and points out why neither is a good description of reality. It also highlights why, despite strong admonishment for the need to broaden logistics officers, logistics generals almost never get what they want.

Pyramidal career progression assumes the classic form of structures in the Egyptian desert (Figure 1). Ideally, the top of the pyramid has one brick—for this analogy, a General. From top to bottom the number of bricks in each layer is established by mathematical formulas which govern the height of the structure relative to the area of the base.* One example of such a formula is shown in Table 1. This formula is just for illustrative purposes since the dynamics that determine true career field structures are too complex to be reduced to such a simple formula. However, regardless of the exact shape or size of the pyramid, certain assumptions are evident when using the pyramid analogy to refer to career progression.

The obvious assumption is that most people at the bottom aspire to whatever room is available at the top. The analogy also assumes that an objective of advancement is to place one's self in a position to compete for vacancies at the next higher level.

Why is it, then, that so many officers seem to aspire to only the first half of the pyramid? Why is it that senior people insist on maintaining officer specialists at all grade levels when advancement requires generalists? For answers, the ideal must be compared with reality.

Although arguable, there are two General positions in the Air Force to which nonrated logistics officers may aspire: command of either Air Force Logistics Command or Air Force Systems Command. At the low end of this pyramid, there are currently about 900 logistics second lieutenants in the Air Force. These numbers would appear to suit an ideal pyramid—a broad base of lieutenants and near unity at the top. But the system does not work that way.

There are many reasons why the Air Force is not structured like the ideal pyramid. It is predominantly a flying service. For good reasons, the preponderance of Air Force generals are (or were) flying officers. That skews the top of the pyramid for nonrated types. More significant, however, is that no Air Force policy or document has ever asserted that the ideal personnel structure should match an "ideal" mathematical pyramidal shape. But, rather than spend a lot of time explaining why the logistics pyramid is not ideal, let us take a look at reality, which is far from ideal.

From bottom to top, the logistics pyramid has a considerable bulge above the bottom level (Figure 2). Reasons for the bulge are best left to the manpower experts, but this phenomenon is both intentional and necessary. Regardless, from a career progression standpoint, the pyramid (if it can still be so called) lends itself to reasonable job (and thereby promotion) opportunities through the grade of colonel—no fewer than half as many "bricks" from any one level to the next higher.

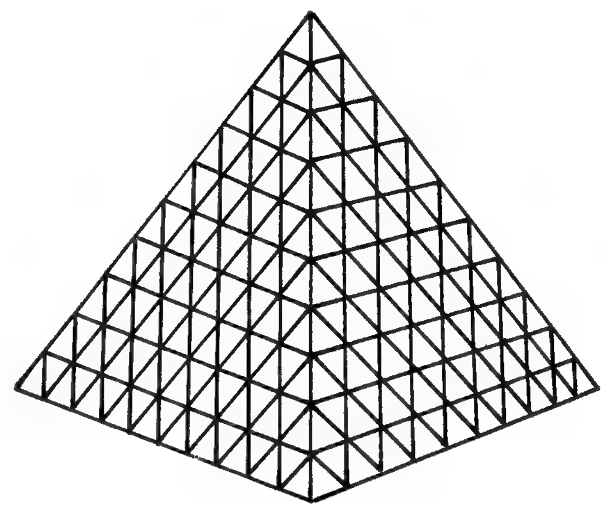

Figure 1: The Ideal Pyramid.

RANK	LAYER: X	OFFICERS: $y=(2x-1)^2$
Gen	1	1
Lt Gen	2	9
Maj Gen	3	25
Brig Gen	4	49
Col	5	81
Lt Col	6	121
Maj	7	169
Capt	8	225
1st Lt	9	289
2nd Lt	10	361

Table 1: The Ideal Pyramid.

*In the real world, personnel structures are determined by experience requirements, promotion/retention patterns, and interrelationships with other career fields (i.e., cross-flow, career-broadening, etc.).

However, here again, the system does not really work that way.

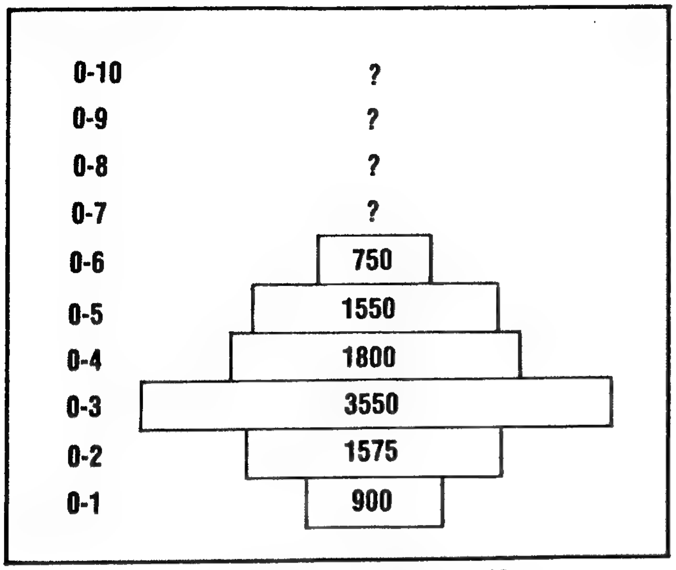

Figure 2: The Logistics Pyramid.

First, general officers are not career designated as logisticians—or anything else for that matter. As the name implies, they are generalists. They are selected for positions based on background, individual talent, and "the needs of the Air Force." So, by the time officers reach the grade of colonel, they are competing for jobs (as opposed to promotion), not against all other *logisticians,* but against all other *officers* regardless of career field. Second, although logistics officers may desire a few nonrated jobs at the very top, they are in reality competing for jobs only at the next level, which may or may not have a proportionate share of nonrated vacancies.

With 750 logistics colonels supposedly aspiring for what *might* be (but almost never is) two logistics General slots, a great many people put the effort in their "too-hard-to-do" file. Through the grade of colonel, the greatest effort officers must exert is that which will place them in the upper half of their contemporaries. Beyond colonel, two chances for promotion exist—slim and none. This is where stovepiping rears its ugly head.

> ***"Although the current Air Force logistics leadership abhors stovepiping, 'the system' demands otherwise."***

When a career field is not pyramidal, it is said to be stovepiped. Although not truly in the shape of a stovepipe (it is more like a nuclear power plant cooling tower), the term refers to specialties with almost the same number of people at the top as at the bottom. The term also applies to people who have not broadened their experience as they progress up through the ranks—those who do not advance toward generalists. Although the current Air Force logistics leadership abhors stovepiping, "the system" demands otherwise.

The Air Force assignment system involves a long process to put specific people into specific jobs. Colonels in key positions throughout the service play strong roles (sometimes overriding all other considerations) in determining who gets which jobs. These key colonels are often the same ones that hold out hope for promotion to general, despite stiff competition that rarely allows mistakes. Competition is so keen that the smallest differentiation weighs heavily.

Because colonels who are responsible for mistakes do not become generals, they insist upon hiring people who are least likely to make mistakes. They want officers with good reputations and extensive experience in their respective career fields—they want specialists. Officers who therefore gain a reputation for being good at their early jobs are forced to stovepipe, even though they must broaden themselves to maintain favor with the generals.

Ironically, people who do not maintain good reputations are not sought by colonels. They are therefore allowed to take career broadening assignments. Although breadth of experience is but one of many "squares" that promotion boards purportedly look at, and assuming the current logistics leadership (which does not like stovepiping) is represented on promotion boards, guess to whom the Air Force infers the better chance of getting promoted?

Realization of the problem does not seem to force solutions. The same officers who, 12 years ago, sat around lamenting the situation are today the colonels who demand specialists. They are also the same people who were dragged kicking and screaming into initiatives aimed at broadening logistics officers. Here is but one example of what happened.

Concurrent with the development of production oriented maintenance organizations (now called combat oriented maintenance organizations, or COMO), the maintenance career fields were combined into one specialty code at the field grade level. The idea was that junior officers would specialize in one of several maintenance areas, then become more and more general at intermediate and senior levels. The concept is consistent with Air Force desires for senior people who are generalists.

> ***"There has never been a single munitions officer promoted to general."***

Reality, however, turned the concept upside down. Within COMO commands (the tactical and, perhaps soon, strategic forces), junior officers who have been trained as specialists find themselves employed as generalists. Since peacetime sortie generation is the driving motive, maintenance officers are being used in whatever capacity achieves that end—regardless of specialty.

Conversely, field grade officers are becoming more-and-more specialized. Officers who start in the Strategic Air Command (SAC) are likely to spend most of their careers there. The same is true for the tactical air forces (TAF) and the Military Airlift Command (MAC). A munitions officer who gets tagged as a "nuke puke" will probably remain so. At every level of command and management above base or wing, despite the fact that the Air Force specialty code is the same, maintenance officers are *not* integrated. People with munitions backgrounds work solely munitions issues, and people who grew up in aircraft maintenance perform staff functions in that specialty. The few who have managed to make the transition are tagged as people who are going places. As noted earlier, however, the transition is not easy. Colonels who run separate logistics functions rarely let the good performers go—and usually only after the intervention of a general officer.

Recent initiatives to again force the issue have fared no better than in the past. Suggestions to realign staff functions to

more closely reflect combat organizations meet with immediate and loud resistance. Activity within the munitions career field serves to focus the example.

Almost as much energy goes into trying to maintain "the munitions community" as goes into acquiring and maintaining the munitions themselves. This, despite some very good arguments that current munitions functional alignment is nothing more than parochialism and makes about as much sense as maintaining a "toilet bowl community." Munitions, though somewhat specialized, are just another commodity. Why not align munitions distribution and storage with standard supply functions? Munitions loading personnel work on airplanes to generate sorties. Why not align them with aircraft maintenance? Explosive ordnance disposal people do not maintain anything but their own equipment. Why not align them with base support functions? Finally, munitions officers are of necessity well-versed in maintenance, supply, transportation, planning, and support. Why are they not considered among the broadest of career logisticians rather than as *the* classic example of stovepiping?

This example is not meant to be an indictment of only munitions officers. Similar examples exist in each of the logistics specialties. Young officers in plans, fuels, procurement, supply, aircraft maintenance, and munitions become old officers in plans, fuels, procurement, supply, aircraft maintenance, and munitions. And the energy that goes into maintaining stovepipes is so phenomenal that an outside observer might think it is the road to success in the Air Force. Yet, to use the example again, there has never been a single munitions officer promoted to general.

So what is the answer for loggies who do not want to be stovepiped—the people who have not yet established a too-hard-to-do file? Asking the colonels for relief has not helped. Trying to grow generalist colonels did not seem to work either.

It seems that without direct intervention from senior Air Force leadership, officers are bound to what "the system" does rather than what it says it wants. The only other recourse is to wait to see what happens with the COMO experience.

"We do not intend to allow stovepiping to continue; we want to be generalists; and we want to compete fairly for our share of the few jobs above the middle of the pyramid."

An interesting phenomenon is developing as a result of the COMO flip-flop of young generalists and old specialists. Where will the next generation of old specialists come from if young officers are generalists? Which way will the intermediate grade officers go—those who grew up with COMO, but are now forced to be specialists? These questions have been asked rhetorically for far too long. It is time to speak up and ask them in the open.

Although this essay surely does not speak for all loggies, it speaks for some. And what it says is that we do not intend to allow stovepiping to continue; that we want to be generalists; and that we want to compete fairly for our share of the few jobs above the middle of the pyramid.

(Lt Col Templin, a career munitions officer, is a Colonel selectee.)

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3. Colson, Frank J. *Automated Analysis for R&A*. AFLMC Report #780105-1. Air Force Logistics Management Center, Gunter AFS AL, December 1978.
4. Dietsch, Lt Col David A. and Maj Clarence T. Lowry. *Wartime Automation Requirements for Maintenance*. AFLMC Report #800402. Air Force Logistics Management Center, Gunter AFS AL, November 1982.
5. Gagnon, Jack. *Military Supply and Transportation Evaluation Program*. AFTPC/DSDO/LGTT, 1985.
6. Gagnon, Jack. *Military Standard Transportation and Movement Procedures*. AFTPC/DSDO/LGTT, 1985.
7. Gagnon, Jack. *Traffic Management Workload Reporting and Productivity System*. AFTPC/DSDO/LGTT, 1985.
8. Mark, CMSgt George R. *Personnel Support for Contingency Operations (PERSCO) Mobile Minicomputer System, Test Loading Operational Test and Evaluation*. MAC Project #17-/LD51411A. USAF Airlift Center, Military Airlift Command, Pope AFB NC, 1981.
9. Rudder, Robert. *On-Line Cargo Movement System*. AFTPC/DSDO/LGTT, 1985.
10. Stone, Eugene F. *Research Methods in Organizational Behavior*. Goodyear Publishing Company, Inc., Santa Monica CA, 1978.
11. Stubbs, Major Gregory D. *Movement Control: Enhancing Defense Transportation System Support for Resupply During Contingency Operations*. Student Paper #2315-81. Air Command and Staff College, Maxwell AFB AL, 1981.
12. Van Scotter, Capt James. *Computer Aided Transportation System*. AFLMC/LGT, 1985.
13. Volkman, Col Thomas L. *Computers — America's Achilles' Heel*. Student Report #LD50867A. Leadership and Management Development Center, Maxwell AFB AL, 1982.
14. Walker, Major Harry. *Freight Documentation Automation*. AFLMC/LGT, 1985.
15. Watts, W. Bruce. *In House Minicomputers Bring Problems for Functional and Data Automation Personnel*. Student Report #LD52461A. Leadership and Management Development Center, Maxwell AFB AL, 1982.
16. Wiley, Robert. *On-Line Vehicle Integrated Management System*. AFTPC/DSDO/LGTV, 1985.
17. Winters-O'Neal, Capt Kathleen, *Austere Location Vehicle Management System (ALVEMS)*. AFLMC/LGT. Air Force Logistics Management Center, Gunter AFS AL, 1985.

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equipment, a 50% increase in aircraft reliability could be realized, and common, "generic" test equipment could be used to support the whole range of modern tactical aircraft.

Reviewing the Bidding

The composite tactical fighter wing concept *can* be implemented if the operational community needs it. From the logistical standpoint, despite the fact that some tough problem areas would require working, the concept is supportable and could be implemented almost immediately. Logistics impediments in facilities, spares, and manpower can all be solved or worked around. With the knowledge gained from operational experience, refinements could take place at a rapid rate, with a marked increase in combat capability. But to fully and permanently profit from the full potential of the concept, we should turn our maintainability and reliability efforts to existing aircraft and apply technology to a rapid update of present support equipment. The same futuristic thinking that spawned the composite fighter wing concept can be fostered to support it.

References

1. Jones, Thomas V. "Logistics and the Military End Zone." *Defense Management Journal*, Vol 19, Fourth Quarter, 1983, pp. 12-16.
2. McIlvaine, Paul J. "Acquisition Logistics Education," *Logistics Spectrum*, Spring 1984, pp. 13-16.
3. Reynolds, Col John C., and Maj Fred G. Saliba. "Fielding Future Weapons: A Mandate for Logistics Research," *Defense Management Journal*, Third Quarter, 1984, pp. 13-18.
4. Wiswell, Col Robert A. "The Composite Fighter Wing: A New Force Structure and Employment Concept Needing Logistical Attention," *AF Journal of Logistics*, Summer 1986, pp. 11-14.

Obligation Rates for Current Year Procurement Dollars

The Air Force is giving more and more attention to obligation rates for current year procurement dollars. Although this money will not expire for three years, there is increased congressional scrutiny of the Air Force's ability to obligate dollars in the year appropriated. Dollars not obligated within the same year signal review officials that funds were prematurely requested—even though the requirements may be valid. Office of the Secretary of Defense (OSD) analysts and congressional staffers are meticulously evaluating program execution and the validity of the Air Force's requirements. Consequently, personnel must closely examine all new requirements and budget requests to ensure applicability to current year funding. Those involved in program execution (HQ USAF, MAJCOMs, ALCs, and Product Divisions) must redouble efforts to award contracts in the year in which funds are appropriated. Advanced planning and timely documentation are key to program execution. Failure to address this situation now could result in a loss of critically needed funding later. (Ms Ethel Jones, AF/LEXP, AUTOVON 225-7031)

Inconsistencies in DOD 5100.76-M

During review of DOD 5100.76-M, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives,* the Air Force identified inconsistencies in the rules for categorizing sensitive, controlled, and pilferable material as outlined in other DOD publications. The nature of these items requires consistency in their identification to ensure they receive the appropriate level of protection and handling through all logistics modes. As a result, OSD is directing review and revision of several DOD publications to establish uniform categories for such material. In the interim, special care must be taken to prevent compromise of these items while in the logistics system. (Maj Victor Wald, AF/LETT, AUTOVON 227-4742)

JP-8 (F-34) As Standard Aviation Turbine Fuel

In April 1986 the NATO pipeline committee unanimously agreed to adopt JP-8 (F-34) as the standard aviation turbine fuel for use by allied land-based aircraft in NATO Europe. In addition to promoting standardization and interoperability, this initiative will significantly enhance combat survivability and ground handling safety. JP-8, which has a minimum flashpoint of 100°F, as compared to -20°F for JP-4, has been used at USAF bases in the United Kingdom since 1979. In addition to replacing JP-4, JP-8 will also replace diesel fuel in automotive equipment, simplifying logistics support requirements. JP-8 is basically commercial JA-1 with a military additive package which includes a fuel system icing inhibitor, corrosion inhibitor, and conductivity additive. Conversion of bases in Central Europe and Spain should be completed by July 1988. (Lt Col Larry Dipoma, AF/LEYSF, AUTOVON 225-0461)

Technical Logistics Reference Network

AF personnel have often asked for computerized data base containing all the information pertaining to every national stock number (NSN) item in the *Federal Supply Catalog*. Given the name of an item, its description, and manufacturer or part number, such an index would instantly yield complete data on the item. While this reads much like a marketing pitch for a vendor, it is not. Many field units and agencies are presently on-line with a data system that greatly simplifies their cross-referencing catalog routine—so much that it is amazing "the word" has not spread faster. The new system illustrates how individual Air Force units can take advantage of new capabilities in the commercial arena to greatly improve their performance. Units such as the 4950 Test Wing at Wright-Patterson AFB, base supply at Nellis, Plattsburgh, Wright-Patterson, and Laughlin AFBs, and others have discovered the Technical Logistics Reference Network (TLRN). These units subscribe to the Fedlink program of the Library of Congress using a variety of hardware already on hand. This provides access to the services provided by Innovative Technologies, Inc., Mclean, Va. TLRN has not only the *Federal Supply Catalog* on-line but also the *Commerce Business Daily*. Soon it will add *Dunn and Bradstreet,* which lists names and addresses of 400,000 manufacturing sources classified by what they make and are capable of making. They will also soon bring on-line Military Handbook 300, *Aerospace Ground Equipment*. In addition, there are other similar services such as "Haystack" by Image Conversion Technology and the Inventory Locator Service from which to choose. These capabilities have great use for anyone involved in the provisioning or support equipment recommendation data (SERD) review processes as well as for competition advocates and item managers. (Lt Col Paul Davis, SAF/ALG, AUTOVON 225-7987)

Improved AFTO System

The Air Force technical order (TO) system is in the process of a major face-lift. The Automated Technical Order System (ATOS) will automate much of the current cumbersome, manual system. Phase I of ATOS automates the TO change process by providing "word processor" type work stations instead of the labor-intensive cut-and-paste operation now used. Phase I will be fully operational at all air logistics centers by March 1987. Phase II will provide the capability to accept, store, and distribute technical data in digital form instead of the large quantities of paper currently delivered by contractors. Phase II is scheduled for implementation starting in FY88. Phase III of ATOS will provide the ability to quickly distribute TO changes in digital form to base-level users. The end result of ATOS will be an automated system, providing more accurate TOs to the users by significantly reducing the time involved in processing and distributing TO changes. (Mr Joe Albergo, AF/LEYE, AUTOVON 227-0311)

USE Program

The Air Force is formally implementing its Used Solvent Elimination (USE) program. Used solvents are hazardous wastes which can easily damage the environment and threaten human health if not properly disposed of. Recent changes to Federal law increase the potential for significant clean-up costs and other liabilities to the Air Force if wastes are not properly handled. The USE program requires each base to catalog its generated waste, evaluate ways to minimize that volume, and determine the most practical disposal method. Each base's objective should be to perform its mission while minimizing potential liability to the Air Force. (Maj Mark Bischoff, AF/LEYSF, AUTOVON 225-0461)

Logistics Plans Manpower Standards

During the last year-and-a-half, the Air Force has worked hard to develop a manpower standard for the base-level Logistics Plans function. At the request of AF/LEX, AFLOGMET conducted a Feasibility Study during the February-November 85 period and concluded that it could pursue development of an Air Force manpower standard and establish a new flying activity category (FAC) to identify the wing/base-level Logistics Plans function. (As a result, all base-level Logistics Plans personnel now fall under FAC 4021.) In late July, AFLOGMET sent a draft measurement plan to all affected MAJCOM and base manpower and engineering teams. The study itself will take about a year to complete. (Maj David Fortna, AF/LEXX, AUTOVON 225-4960)

Blue Two Visit (BTV) Program

The Air Force is striving to improve the reliability and maintainability (R&M) of its weapon systems by establishing an on-going dialogue between USAF maintainers and system designers. An important initiative to help accomplish this objective is the Blue Two Visit (BTV) Program. Named for the blue-suit, two-stripe airmen on the flight line, this program introduces industry design engineers and Air Force acquisition personnel to the real-world operating environments experienced by maintainers. During a typical visit to various bases, system designers personally experience the supportability concerns maintainers face on a daily basis. The Blue Two Visit Program facilitates "user-designer" interface and leads to the design of highly reliable systems which are built to be maintained in the operational environment (see the Combat Support R&D section of this *AFJL*. (Capt Frank Bruno, AF/LE-RD, AUTOVON 227-9388)

Simulator Maintenance Technician Phaseout

Over the next five years, the Air Force will be phasing out military simulator maintenance technicians—this function will be accomplished by contractor logistics maintenance. This decision was due to the critical need to conserve military authorizations for direct maintenance support of current and programmed weapon systems. The Air Force is keeping older weapon systems longer than originally expected (B-52, F-4, A-7, F/FB-111), and new systems (B-1B, small intercontinental ballistic missile (ICBM), Peacekeeper, advanced tactical fighter (ATF)) are programmed for inventory without additional manpower resources to maintain them. This situation, coupled with a General Officer Blue Ribbon Group recommendation and subsequent decision that simulator maintenance is a contractable activity, was the catalyst for this maintenance policy change. In May 1986, HQ USAF issued a Program Management Directive to initiate the simulator maintenance technician phaseout. Over 2,200 military positions (AFSC 341XX) will be eliminated in the next five years with those authorizations being shifted directly to aircraft and missile maintenance. The military personnel previously in the simulator maintenance field are being retrained to occupy these new positions, capitalizing on their extensive electronics background. Contractor support for the simulators will range from contractor maintenance and logistics support to total contractor training of operational personnel. (Lt Col Bob Meek, AF/LEYY, AUTOVON 227-5642)

Artificial Intelligence and Expert Systems

The Air Force (AF/LEXY) is currently exploring new ideas for the application and implementation of artificial intelligence and expert systems in the overall logistics arena. Investigative academic work has been completed for an expert system for item managers. The initial results of this work are very exciting, both in productivity enhancement and increased work accuracy. (See article, *AFJL*, Winter 1986.) Robotics vision systems using the artificial intelligence techniques are also being explored. Some exploratory systems are currently under development in aircraft maintenance. (If readers have ideas they think have potential for artificial intelligence/expert systems in the logistics community, call Capt Joe Michels, AUTOVON 225-6788.) AF/LEXY is also exploring the potentiality of vericodes, highly encrypted, computer-generated identifiers which are formatted as multidimensional "bar codes." Thus far, feedback has been positive. Vericodes can be produced on products as well as documents for automatic identification, anti-counterfeiting, and security identification. (If readers need additional information on the vericode technology, call Ms Jane Channell, AUTOVON 225-6715.)

"The problem was that there was no time or opportunity for quiet conversation or even for quiet contemplation. Exhausted, harassed, beseiged men found it necessary to concentrate on tactics rather than strategy, on micro problems rather than macro solutions, on today's crises rather than tomorrow's opportunities."

Chester Cooper, *The Last Crusade*, 1970.

My SON: The Operational Need

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Introduction

Back in my enlisted days as an aircraft mechanic, I had no idea how new weapon systems entered the Air Force inventory. Frankly, I didn't care. It was magic. One day we didn't have them and the next day we did. My concern was to keep the ones we had flying. But having been involved in Department of Defense (DOD) acquisition for several years, I've become painfully aware it wasn't magic but rather a very arduous, demanding, and time-consuming task. Of all I have learned about acquisition, one fact continually permeates my thoughts—the need for early formulation and coordination of the requirements, strategies, and support concepts to be employed in a new acquisition. If the formation of a program office is the "birth" of an acquisition, the identification of a using command's inability to perform any or all of its mission due to system/equipment deficiencies is a program's "conception." The identification of these deficiencies is most often made by a using command or separate operating agency (SOA) through preparation of a Statement of Operational Need (SON) in accordance with 57-1, *Operational Needs*.[1]

"Many individuals directly involved in the acquisition of a system have never read the SON for their own program."

Despite its importance, there is not widespread understanding of the purpose and use of the SON. At AFIT, I have found that many individuals directly involved in the acquisition of a system have never read the SON for their own program. It is, therefore, the intent of this article to describe a few of the more significant changes that have occurred in the preparation and coordination of a SON and to call attention to the importance of such a document.

Over the last several years, DOD has been intensively striving to streamline the acquisition process. The purpose is to decrease system acquisition time and reduce procurement and support costs, while at the same time trying to optimize the types and mix of systems and equipment needed to meet military objectives. This is no easy job when one considers that we have more validated user needs than we have money with which to satisfy them. Therefore, we must be very selective in our choice of needs. Once selections are made, we must give keen attention to establishing their performance and support requirements. Virtually all the time, effort, and money spent to analyze, design, test, produce, and deploy a system are expended to satisfy a user's expressed operational need.

SONs are prepared by a using command or separate operating agency. However, as pointed out in the Packard Commission Report to the President on Defense Acquisition, "Generally, users do not have sufficient technical knowledge and program experience."[2] As a result, the users are not as intimately familiar with the multiplicity of interrelated activities in the acquisition process as are the Air Force Systems Command (AFSC) and Air Force Logistics Command (AFLC) people who perform acquisitions as a normal part of their everyday business. On the other hand, the Packard Commission Report also stated that "acquisitioners generally do not have sufficient experience with or insight into operational problems."[3] Clearly, a symbiotic relationship must be developed between "users and acquisitioners" to improve the probability of program success. It is incumbent upon those trained and experienced in the acquisition process to assist using commands in the development of need statements and other related documents.

Improving the Acquisition Process

In May 1985, the Air Force issued a major revision to AFR 57-1. This change, coupled with the release of AFP 57-9, *Defining Logistics Requirements in Statements of Operational Need,* and the AFLC initiative of collocating AFLC acquisition logisticians at various using command headquarters, is a significant step toward improving the system acquisition process.

AFR 57-1 Revision

In order to appreciate what the revised AFR 57-1 has done to improve the acquisition process, it is appropriate to point out generalized shortcomings of the previous version. First, the former version made the preparation of a draft SON optional; now, a "For Comment" SON (same as a draft) is mandatory. For many years there has been great concern at all levels in the DOD and higher over the ever-increasing time required to complete an acquisition program. Preparing a For Comment SON might contribute to this increasing time; but it must be clearly understood that decisions made in the early stages of an acquisition are significant determinants of the performance, support structure, and eventually life cycle cost of that system. Lieutenant General Marc Reynolds, AFLC Vice Commander, pointed out that, as a result of early program decisions, about 70% of the life cycle cost of a system has been committed by the end of the first phase of the acquisition cycle (concept/exploration), 85% by the end of the second phase (demonstration/validation), and 95% by the end of the third phase (full-scale development).[4] But, in actuality, only about 10% of the system's life cycle cost has been *spent* by the end of full-scale development.[5] These early program decisions are based upon user requirements specified initially in the SON and later made more detailed in the System Operational Concept (SOC) document. It makes good planning sense to pay close attention to these documents during their initial preparation and throughout the acquisition program. The TV commercial "Pay me now or pay me later" (be it payment in money or time) has a profound applicability to the DOD

acquisition process. If adequate attention is not given to the development of initial requirements, we will most certainly pay later. Still, it should be emphasized that, while the new AFR 57-1 mandates the preparation of the "For Comment" SON and specifies a time frame for its review, it still remains the responsibility of acquisition specialists to see that the review is thorough and productive.

> **"Originators are now permitted to propose a solution to the deficiency in the body of the SON."**

Second, the previous SON format was the same for all operational needs, regardless of the potential program size. Further, it did not allow the user to recommend potential solutions to the need in the body of the SON, nor was it very detailed on the required SON content.[6] Additionally, programs directed by higher authority usually required no SON. The revised regulation now identifies four new SON formats (A, B, C, and D) of which format D is used to document higher authority directed programs. Format A, B, or C is selected based on the expected program size (usually dollar value and/or decision authority). In addition, SON originators are now permitted to propose a solution to the deficiency in the body of the SON. They must also address, in more detail, system performance and operational requirements as well as logistics thresholds, goals, and constraints.[7]

The third, and maybe most significant, difference concerns the degree of early coordination by the using, implementing, and supporting organizations on system requirements. In the previous version of AFR 57-1, numerous agencies were given the opportunity to review and comment on SONs. However, the regulation sorely underemphasized the need for a formal acknowledgment of understanding and agreement by the using, implementing, and supporting commands on the user's performance and support requirements, the implementing command's programmatic approach, and the supporting command's logistics concepts and strategies. The May 1985 revision provided for the concurrence/nonconcurrence of major participants on these issues. Too often a system's performance requirements, design, or support concepts have been changed after the program was well underway. Surely, some changes may be absolutely necessary, but we should be concerned about those changes caused by inadequately defined coordinated requirements. Any significant change is going to cost time and money. The expense of necessary changes must be accepted, but changes caused by fluctuating requirements are unnecessary. Hopefully, the new SON coordination procedure will minimize, if not eliminate, untimely and unnecessary changes. An early understanding and agreement on the requirements, strategies, and support concepts for a new system can go a long way in smoothing bumps on the road to an acquisition.

Addition of AFP 57-9

A complementary publication to AFR 57-1 is AFP 57-9. AFR 57-1 gives specific guidance on SON format, but having a prescribed format merely dictates how many sections are required, their arrangement, and topics/subtopics of each section. It is the SON's content rather than its format that sets the stage for an acquisition. AFP 57-9 was developed to assist in SON content development. This pamphlet defines procedures and outlines guidance for including readiness and logistics requirements in the SON.[8] Though primarily created to aid SON originators, all who are involved in the acquisition of systems and equipment would benefit from a general knowledge of its contents.

Specifically, AFP 57-9 provides guidance on the preparation of logistics inputs to SON formats A, B, and C. It can aid in developing readiness related requirements for aircraft, missiles, munitions, communication equipment, space systems, trainers, support equipment, etc. Included are samples of logistics inputs along with points of contact for the various logistics elements. It also includes a list of current regulatory guidance relevant to the logistics elements. The revision to AFR 57-1 and the addition of AFP 57-9 were undeniably needed. But there was still an element mission—that of human knowledge and experience.

Importance of Human Element

HQ AFLC, in consonance with several major using commands, has placed trained, experienced logisticians at their major command headquarters. These logisticians assist in the evaluation and preparation of logistics requirements for inclusion in SONs and SOCs. Currently, AFLC logistics liaison officers are located at MAC, TAC, SAC, and Space Command Headquarters. The potential benefits of this mutual support range from minimizing SON preparation and coordination time to maximizing the influence on the prime system's design for supportability. Maybe this approach will allow the acquisition world to do away with the old maxim, "We never have time to do it right the first time, but we always have time to do it over."

Development of PSOC/SOC

One other point must be made. Once a program has begun, the using command still has many responsibilities throughout the acquisition. One of the most crucial is the development of the Preliminary System Operational Concept (PSOC), which will eventually be finalized as the SOC. The PSOC must be ready for review by the Milestone I—the point when a program is ready to transition from the concept exploration phase to the demonstration/validation phase of the acquisition cycle. The PSOC/SOC has a prescribed format and content (see AFR 55-24, *System Operational Concept)* and a required distribution for review and comment. Its purpose is to describe the mission, operating environment, employment and deployment strategies, support concepts, and safety requirements for each alternative system being considered to solve the deficiency identified in the SON.[9] It is in much greater detail than the SON and must reflect a system that encompasses the requirement specified in the previously validated SON. The SOC identifies and establishes qualitative and quantitative levels of systems performance and support. Once the final alternative system is selected, the PSOC becomes a SOC and, realistically, becomes the requirements document the program office uses during the system/equipment acquisition. It should be common practice for the PSOC/SOC to have the same level of review and attention as is warranted for the SON.

Conclusion

The goal of the Air Force acquisition community is to provide systems and equipment that meet user performance

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CAREER AND PERSONNEL INFORMATION

Civilian Career Management

Career Programs Management Information System

In the Career and Personnel Information department of the *Air Force Journal of Logistics* (Summer 1985 issue), we explained that the Logistics Civilian Career Enhancement Program (LCCEP) is developing an automated Management Information System (MIS) for all career programs at the Air Force Civilian Personnel Management Center (AFCPMC). The MIS supports the day-to-day mission of career programs and provides decision-making support for civilian policy councils and panels.

As part of the MIS, registrant databases allow for fast ad hoc queries and quick statistical analyses. These databases also verify an individual's geographic location availability or provide education, appraisal, promotion, or penalty data. Statistical data show retirement projections by grade and year; total registrant availability by grade, along with command, base, or occupational series; or number of registrants for other than their current duty location. Similar statistical data are also compiled on Cadre members and are updated at AFCPMC to include interview scores and Cadre membership dates.

MIS supports fill actions by providing certificate call worksheets, recording declinations and waivers, and providing up-to-date phone numbers in the registrant records. The system also accumulates certificate statistics which show the number returned without selection. In addition, MIS includes position databases which provide for position identification and tracking. Career program offices are automatically notified about position additions, deletions, and modifications.

In the future, MIS will:

(1) support the selection and tracking of training and career-broadening assignment participants and the rating, ranking, and selection of interns;

(2) track promotions and career changes of participants for analysis and evaluation purposes;

(3) include career development programs by type, prerequisites, and characteristics; identification of individuals requiring career development and tracking of their participation; and evaluation of career development efforts;

(4) support Promotion Evaluation Pattern (PEP) development and consistency in skills coding; and

(5) cover special projects unique to certain career programs and provide internal tracking for AFCPMC projects, training, and budget.

In summary, MIS provides high-quality information to policymakers and senior logisticians and managers while supporting the operations of AFCPMC. This means better service to program registrants. MIS is scheduled for completion in 1987.

Source: C. Marie Pierce, AFCPMC/DPCMLD, AUTOVON 487-5631.

Editor's Note: The Military Career Management department will return next issue.

READER EXCHANGE

LOGISTICS VS COMBAT SUPPORT

I must take issue with my friend, Jerry Peppers, in his recent letter (*AFJL*, Summer 86) about the reason behind the decision to use the term *combat support* in lieu of *logistics* in the Air Force's new doctrine manual, AFM 2-15, *Combat Support Doctrine*.

In the article, "The Doctrinal Challenge: A Rebirth of Logistics Thought" (*AFJL*, Winter 1985), the author points out the primary argument for using *combat support* was "... to bring doctrinal coherency and unification to the Air Force community...," particularly the support community. The Jominian view of war—comprised of a triad of strategy, tactics, and logistics—is unfortunately not a commonly held idea in the Air Force. Essentially, "blue suiters" confine *logistics* to transportation, supply, maintenance, logistics plans, and (with less conviction) to contracting, services, and engineering. Our Service also tends to focus on materiel, diminishing the importance of logistical activities associated with people, facilities, and information. Consequently, AFM 2-15 defines *combat support* to include all military support functions. In effect, combat support encompasses everything but operations, although it is dominated by logistical activities. (The proportion of these logistics activities could range from 80% to 100% depending on the individual or group making the assessment.)

However, I want to assure Professor Peppers and logisticians everywhere that *logistics* is not being expunged from the Air Force lexicon. In fact, in the last couple of years, logistics has received greater emphasis than at any other time in our aerospace history. Witness the growing influence of the *Air Force Journal of Logistics*, the resurgence of logistical course content at our military schools, and our increasing success in promoting logisticians and financing logistics programs.

Moreover, we will continue to elevate logistics concepts, philosophy, and doctrine to a level commensurate with its importance in war fighting. We are now in the process of writing follow-on logistics doctrine for space/nuclear, high-intensity, and low-intensity conflict. And, we are also heavily involved in the development of joint logistics doctrine commissioned by the Office of the Joint Chiefs of Staff. In all these efforts, we plan to restrict our work to the "pure" logistical activities of acquisition, distribution, restoration, and disposition. But all these doctrinal undertakings would have been impossible without the conceptual foundation established in AFM 2-15, and that foundation would have been faulty had it failed to embrace the entire spectrum of support activity. Just as *strategy* and *tactics* are intertwined in all military operations, *logistics* is and always has been an integral aspect of war fighting. No, we have not abandoned the term *logistics*. Instead, we have legitimized logistics, recognized its full breadth, and emphasized its true military role—combat support.

All that notwithstanding, I welcome as always any comment Jerry Peppers has to make. He is one of our very best.

Lt Gen Leo Marquez
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Provisioning Management in the Air Force Today

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Introduction

Those adept in waging war do not require a second levy of conscripts nor more than one provisioning.

Sun Tzu[1]

When the Chinese military philosopher and general Sun Tzu penned these words over two thousand years ago, the concept of provisioning was already firmly established as a primary concern of military leaders. Those who grasped the essentials of initial logistics support requirements had a chance at victory and greatness; those who did not were doomed to defeat despite other talents and resources.

While there are numerous historical and current definitions of the term "provisioning," the Department of Defense uses the word to mean "the management process of determining and acquiring the range and quantity of support items necessary to operate and maintain an end item of materiel for an initial period of service."[2] In plain English, *provisioning is the process of identifying and acquiring the supply support necessary to ensure that a new system can be maintained during the period of time needed for normal replenishment systems to come on line and provide adequate support.*

This article provides a basic understanding of the concepts, principles, and techniques used to provision weapon systems and other end items in the Air Force today. It views the provisioning process in three phases: planning, data acquisition, and the formal provisioning process which includes actual hardware acquisition.[3]

Planning for Provisioning

Planning for provisioning begins as soon as an end item of materiel is conceived. Such planning will ensure that the appropriate provisioning or Logistics Support Analysis (LSA) standards are cited in full-scale development (FSD) or production contracts or both. Provisioning requirements are included in the FSD contract, whenever possible.[4]

Traditionally, while provisioning planning began early in the conceptual phase of systems acquisition, the actual provisioning effort, including data acquisition, did not begin until the production decision was made. Now, whenever possible, planners should begin that process in the FSD phase by including the provisioning data requirements on the FSD contract. This general acceleration in the timing of the provisioning effort should lead to more responsive and efficient support for new systems (Figure 1).

While provisioning planning is the responsibility of the Program Manager, the Deputy Program Manager for Logistics

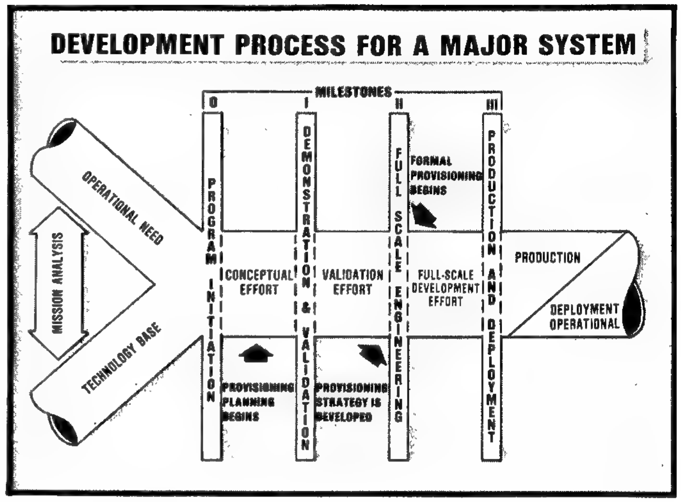

Figure 1: The Provisioning Process As Part of the System Acquisition Process.

(DPML) performs the actual mechanics of the planning effort. The DPML accomplishes this as a joint effort with Air Force Systems Command (AFSC) personnel, specialists from the Air Force Acquisition Logistics Center (AFALC), and provisioning personnel from Air Force Logistics Command (AFLC).

At the core of this planning effort is the selection of a *provisioning strategy* which must be developed in adequate time to allow inclusion of provisioning requirements in the FSD request for proposal. This strategy includes many factors which will have an impact throughout the provisioning effort.

Provisioning Method

Several methods may be used to provision an end item or system. These include appointing a committee of experts at the responsible air logistics center (ALC) to accomplish techni al activities at the depot (so-called in-house, desktop, or depot committee provisioning), sending a team from the ALC to the contractor's facility for a formal provisioning conference, or establishing a permanent team at the contractor's plant (resident provisioning team method).

Spares Acquisition Integrated with Production

Strategy development should consider the use of spares acquisition integrated with production (SAIP).[5] Under SAIP, certain support items intended for use as spares and repair parts are purchased along with similar items intended for production installation on the end items. The advantage of this procedure is it results in greater opportunities for savings through the economies inherent in larger scale purchases. Additionally, by

combining the production run for end item installs and spares, the configurations will be identical.

Contractor Support

Provisioning planning and strategy development should consider the possibility of contractor support in lieu of organic support, either as an interim measure or for the life of the program. This "contractor logistics support" option is particularly attractive when the planned system consists of a limited number of end items, the end items are subject to considerable design instability, or the system is not expected to remain in the inventory very long. In such cases, it is often economically attractive not to develop organic support capabilities.

Interim contractor support should be considered for items entering the inventory during the early production phase of the system acquisition life cycle when:

> (1) they are of poor reliability or unstable design; (2) they have a high unit cost and require sizable initial investment; (3) the probability of design obsolescence or expensive modification is likely; or (4) the logistics support is not in place.[6]

Requirements Determination and Pricing

While an extended discussion of requirements determination and pricing is beyond the scope of this article, the provisioning planning process should involve the selection of appropriate requirements computation and pricing methodologies. The recent and ongoing scrutiny being directed toward these areas makes it crucial that realistic spares requirements be coupled with prices which represent the inherent values of the assets.

Interim Release

Some assets identifiable as logical spares simply take longer to manufacture than the time available in the normal provisioning process. To ameliorate this problem, the Air Force developed a technique known as *interim release*. When the provisioning strategy calls for this, the contractor prepares a long leadtime items listing (LLIL) which specifies items in this category. The items on the LLIL may be entered into production prior to completion of the normal provisioning process and prior to receipt by the contractor of a specific order for the items. Items already identified by a national stock number are not normally considered for interim release.

Data Acquisition

The heart and soul of the provisioning process is data acquisition and management. A common saying among those involved in provisioning in the Air Force is that the process is 90% data and 10% hardware. This admittedly oversimplifies the situation, but it also gives a reasonably accurate idea of the importance of provisioning data to the acquisition of initial spares.

Provisioning management is primarily concerned with provisioning technical documentation (PTD) and supplemental provisioning technical documentation (SPTD). PTD consists of the various listings of data necessary to support the assignment of source, maintenance and recoverability (SMR) codes and maintenance and overhaul factors, to compute requirements, to identify items for interim release and SAIP, and to perform the other technical functions of the provisioning process. Today, this data is accumulated as a part of the logistics support analysis (LSA) process and fed into the AFLC D220 mechanized provisioning system for processing and maintenance. This combination of provisioning data acquisition with LSA is one of the most significant changes in how the Air Force conducts provisioning. It holds hope for truly integrated data processing in support of all aspects of systems acquisition.

SPTD includes engineering drawings, schematics, photographs, and wiring diagrams used in support of provisioning and cataloging actions. This crucial information permits follow-on competition and reprocurement action throughout a system's life cycle. But it is crucial that *only* the data actually required be bought; otherwise, the cost of data acquisition becomes prohibitive.

Formal Provisioning Process and Spares Acquisition

Formal provisioning usually begins with a data call sent out by the implementing activity to the provisioning activity. Normally, this refers to the System Program Office and the System Program Management Air Logistics Center. Historically, this data call would be in support of the production contract. Recently, as already noted, the Department of Defense has determined it is often advisable to begin the acquisition of provisioning data on the FSD contract. Also, current policy states that whenever the FSD contract requires data development under logistics support analysis, provisioning will begin on that contract. A diagram of a typical process is presented in Figure 2. This does not mean that we normally buy spare and repair parts prior to a production decision; rather, it means that we acquire the *data* necessary to determine *which* parts and spares are needed.

Following award of the contract requiring provisioning data development, Air Force activities interested in the provisioning effort formally meet with the contractor at a Provisioning Guidance Conference. This conference, normally held within 45 days of contract award, provides a forum for resolving any questions concerning contract requirements. After this, the contractor develops and delivers the provisioning technical documentation and supplemental provisioning technical documentation.

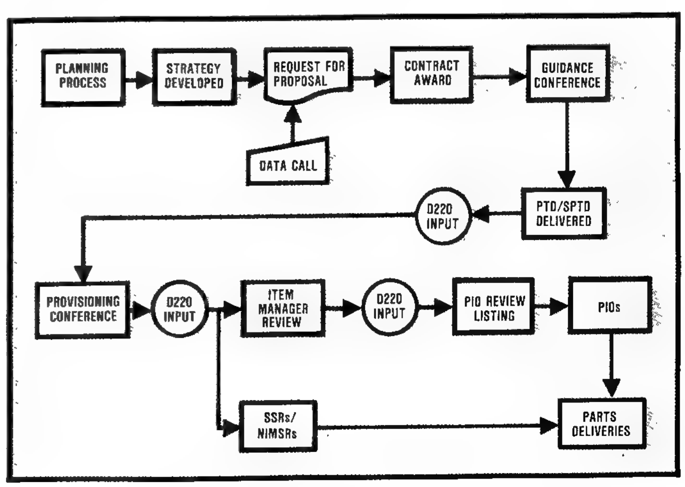

Figure 2: Simplified Typical Provisioning Process.

Once Air Force activities have the necessary data, they assign various codes and factors upon which acquisition decisions are made.* This technical review may be conducted at the depot, at the formal provisioning conference, or by the resident provisioning team, as appropriate under the strategy developed during the planning process. Following these technical processes, managers consider what spare and repair parts will actually be bought.

In general, items identified as logical spares fall into one of three categories: items already in the Air Force inventory; items which are already managed by another federal agency; and new items which are not stocklisted or managed in the federal supply system.

If an item is already managed by the Air Force, it is not normally acquired through the provisioning process. Rather, it is identified to the responsible item manager that the system being provisioned will be a new user of the item. The item manager then includes the new forecast demand for the item in the regular requirements computation and acquisition process.

If the item identified as a spare is already managed by an activity other than the Air Force, or will be managed by another activity, the process is somewhat more complex. For consumable items (those which are not subject to repair), the Air Force communicates its new requirements with a supply support request (SSR). In most cases, the D220 Automated Provisioning System automatically forwards this request via the D169 Supply Support Request and Advice System. The SSR notifies the managing activity that a new requirement exists for the item and identifies the new weapon system as a using system. For nonconsumable (recoverable) items, a nonconsumable item materiel support request (NIMSR) is forwarded to the managing activity. The NIMSR, like the SSR, notifies the managing activity of the forecasted Air Force need for the item.

If an item is not currently stocklisted, and is going to be brought into the Air Force inventory, managers typically acquire it through the provisioning process. The instrument for this acquisition is a *provisioned item order* (PIO). A PIO differs from a normal acquisition in a number of fundamental ways. Most significant is it normally does not have fixed prices or a fixed delivery schedule. The PIO is tendered to the contractor with estimated prices and a desired delivery schedule; the contractor accepts the parts order and then negotiates final prices and schedules after the fact. While this procedure obviously increases the government's risk, it also improves the timeliness of initial support. This is because parts production is not constrained by the time-consuming process of price and schedule definitization.

*In the Winter 1987 *AFJL*, the authors expand on provisioning decision-making and the computation of technical factors which influence a system's support throughout its operational life.

Summary

The provisioning process is of paramount importance to the Air Force and the Department of Defense. Decisions made during this part of the acquisition process affect for many years how well a newly acquired weapon system and its major components will perform in the operational environment. Therefore, it is vital that increased attention be directed to the provisioning process and its relationship to the logistics and operations world. The old poem about inadequate supply support accurately reflects the role of provisioning in systems mission capability:

For want of a nail, the shoe was lost;
For want of the shoe, the horse was lost;
For want of the horse, the rider was lost;
For want of the rider, the message was lost;
For want of the message, the battle was lost;
For want of the battle, the kingdom was lost;
All for the want of a horseshoe nail.[7]

Notes

[1]Griffith, Samuel B., trans. *The Art of War*, by Sun Tzu (New York and Oxford: Oxford University Press, 1963), p. 73.

[2]Department of Defense. *Provisioning of End Items of Materiel*, DoD Directive 4140.40 (Washington: Government Printing Office, 1983), p. 2-1.

[3]Department of the Air Force. *Air Force Provisioning Policies and Procedures*, AF Logistics Command Regulation 65-5 (Wright-Patterson AFB: Hq AFLC, 1980).

[4]Department of Defense. *Provisioning of End Items of Materiel*, p. 2.

[5]Department of the Air Force. *Spares Acquisition Integrated with Production (SAIP)*, AF Regulation 800-26 (Washington: Hq USAF, 1985).

[6]Department of Defense. *Provisioning of End Items of Materiel*, p. 3-3.

[7]Franklin, Benjamin. *Poor Richard's Almanac*.

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requirements, are available to do the job, and are economically supportable. Getting capable, reliable, maintainable, and economically supportable systems requires a cooperative effort on the part of the using, implementing, and supporting commands. This effort must begin with the early identification of realistic requirements in the SON. The revision of AFR 57-1, the development of AFP 57-9, and initiatives such as AFLC's matrixed participation with the users are heading the Air Force in the right direction.

Notes

[1]AFR 57-1, *Operational Needs*, May 28, 1985, p. 2.
[2]The President's Blue Ribbon Commission on Defense Management, "A Formula for Action: A Report to the President on Defense Acquisition," April, p. 21.
[3]Ibid., p. 21.
[4]Reynolds, Lt Gen Marc C. "Using Technology to Improve Readiness and Reduce Cost: Challenges for Contracting," *Air Force Journal of Logistics*, Summer 1985, p. 3.
[5]Defense Systems Management College, "Integrated Logistics Support: A Guide for Acquisition Managers," October 1985, p. 6-2, Figure 6-2.
[6]AFR 57-1, *Statement of Operational Need (SON)*, superseded June 12, 1979, p. 2-4 and Atch 2.
[7]AFR 57-1, *Operational Need*, May 28, 1985, p. 2-10 and Atchs 4, 5, 6, and 7.
[8]AFP 57-9, *Defining Logistics Requirements in Statements of Operational Need*, September 26, 1985, p. 1.
[9]AFR 55-24, *System Operational Concept*, February 28, 1986, p. 1.

"Attrition is not a strategy. It is, in fact, irrefutable proof of the absence of any strategy. A commander who resorts to attrition admits his failure to think of an alternative. He rejects warfare as an art and accepts it on the most non-professional terms imaginable. He uses blood in lieu of brains."

David Palmer, *The Summons of the Trumpet*, 1984.

CURRENT RESEARCH

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(The conclusion of this listing will appear in the Winter issue.)

The Air Force Institute of Technology's thesis research program is an integral part of the graduate education program within the School of Systems and Logistics. The graduate thesis research program is designed to contribute to the educational mission of AFIT's Graduate Program through attainment of the following specific objectives:

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(3) Increase the professional capabilities and stature of faculty members in their fields of study.

(4) Identify military management problems and contribute to the body of knowledge in the field of military management.

Organizations that have potential research topics in the areas of logistics management, systems management, engineering management, and contracting/manufacturing management may submit the topics direct to the School of Systems and Logistics, Air Force Institute of Technology (Lt Col Gary L. Delaney, AUTOVON 785-5023/5096).

The graduate theses listed in this article were completed by Class 1985S of the Air Force Institute of Technology's School of Systems and Logistics. AFIT Class 1985S theses are presently on file with the Defense Logistics Studies Information Exchange (DLSIE) and the Defense Technical Information Center (DTIC).

Organizations interested in obtaining a copy of a thesis should make the request direct to either DLSIE or DTIC, not to AFIT. The "AD" number included with each graduate thesis is the control number that should be used when requesting a copy of a thesis from DTIC. The "LD" number should be used when ordering from DLSIE.

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"When the history of the Vietnam war is told, the significance of the role of logistics in providing the necessary strength when and where it was needed will be more prominent than in any war in the past."

General Jack J. Catton, USAF, "The Role of Logistics in Policy and Strategy," *Strategic Review*, Fall 1973.

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